Prepared for:

Bailey Site Settlors Committee
c/o Parsons Engineering Science, Inc.
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Houston, Texas

TECHNICAL MEMORANDUM
PIT B PRE-DESIGN STUDY

BAILEY SUPERFUND SITE
ORANGE COUNTY, TEXAS

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1. INTRODUCTION

1.1 Terms of Reference

This document has been prepared by GeoSyntec Consultants, Atlanta, Georgia (GeoSyntec) on behalf of the Bailey Site Settlors Committee (BSSC) to present the data obtained from the Pit B Pre-design Study (PDS) for the Bailey Superfund Site, located in Orange County, Texas. The PDS activities were performed in general accordance with the appropriate requirements of the following documents:

- "*Work Plan for the Pit B Pre-design Study*" (WP-PBPDS), [GeoSyntec, 1996a].
- "*Quality Assurance Project Plan*" (QAPP), [Harding-Lawson Associates (HLA), 1991a], as amended by Appendix A of the WP-PBPDS.
- "*Final Sampling and Analysis Plan*" (SAP-HLA), [HLA, 1991b].
- "*Final North Marsh Waste Sampling and Analysis Plan*" (NMWSAP-HLA), [HLA, 1993].
- "*Health and Safety Plan*" (HASP), [Parsons Engineering Science, Inc. (Parsons ES), 1995].
- "*Health and Safety Plan*" (GHASP), [GeoSyntec Consultants, Inc. (GeoSyntec), 1995a.

Pit B was previously sampled by GeoSyntec. Samples collected were analyzed for TCLP volatiles, TCLP semivolatiles, TCLP metals, Target Analyte List (TAL) and Target Compound List (TCL) compounds. The results of this investigation are summarized in the "*Technical Memorandum, Supplemental East Dike Area and Pit B Site Investigations* " (TM-EDA/PB) [GeoSyntec, 1996b]. However, due to the limited number of samples collected, the evaluation of waste characteristics was inconclusive. Therefore, additional sampling was required, as described in the WP-PBPDS to supplement the previous studies.

1.2 Project Background

The Bailey Superfund Site is located approximately 3 mi (5 km) southwest of Bridge City in Orange County, Texas. The site was originally part of a tidal marsh near the confluence of the Neches River and Sabine Lake. In the early 1950s, Mr. Joe Bailey constructed two ponds (Pond A and Pond B) at the site as part of the Bailey Fish Camp. The ponds were reportedly constructed by dredging the marsh and piling the marsh sediments to form dikes along the northern and eastern limits of Pond A (the North Dike Area and the East Dike Area, respectively). Between the time of construction (1950s) and the spring of 1971, Mr. Bailey used a variety of wastes including industrial wastes, municipal solid waste (MSW), and debris as fill material for these dikes.

In 1984, USEPA proposed the site for inclusion on the National Priorities List (NPL). The site was placed on the NPL in 1986. A remedial investigation (RI) was completed for the site in October 1987 [Woodward-Clyde Consultants (WCC), 1987], and a feasibility study (FS) was completed in April 1988 [Engineering-Science, Inc. (Engineering-Science), 1988]. USEPA selected this remedy in the Record of Decision (ROD) for the site, signed on 28 June 1988 [USEPA, 1988].

The remediation area comprises the North Dike Area, East Dike Area, and North Marsh Area. Proposed revised remedies for the North Dike Area and East Dike Area are described and evaluated in the focused feasibility study report (FFSR) [GeoSyntec, 1996c]. While reviewing the available information for Pit B and the North Marsh Area, GeoSyntec observed that the analytical data regarding the chemical characteristics of the waste in Pit B and North Marsh Area were limited. More specifically, at the commencement of the FFS, adequate data did not exist that would allow waste profile sheets to be completed. Waste profile sheets are required to make decisions regarding the technical and regulatory feasibility of off-site disposal, and to obtain cost quotations for disposal. Therefore, GeoSyntec recommended that supplemental site investigations be performed in these areas so that waste treatment and disposal options could be evaluated during the FFS.

The results of the supplemental site investigation for the North Marsh Area are presented in the "*Technical Memorandum, Supplemental North Marsh Area Site Investigation and Evaluation of Original Remedy*" [GeoSyntec, 1995b]. Based on these results for the North Marsh Area, the North Marsh Area is currently being addressed as an interim removal action. The remediation of the North Marsh Area was therefore not included as part of the FFS. A summary of the information available for Pit B from previous investigations is summarized in Section 1.3 below.

1.3 Previous Investigations at Pit B

Pit B is located between Pit "A", the Waste Channel Area in the North Dike Area and the North Marsh Area. A figure showing its location relative to the rest of the Bailey Superfund Site is provided as Figure 1. The original remedial design (ORD) required that waste material within this area be capped following in-situ solidification; this work was not implemented due to difficulties in achieving the specified performance criteria for solidification of the waste in the East Dike Area of the site.

Previous investigations were conducted at Pit B by WCC during the initial RI [WCC, 1987]. Additional samples were collected by GeoSyntec during supplemental site investigation at Pit B [GeoSyntec, 1996b]. In the RI investigation, the depth of waste material and its areal extent were evaluated by probing the depths of the waste material in Pit B at selected locations. It was estimated that the waste material was deeper in the western end of Pit B, where waste depths ranged from 2.0 to 9.5 feet (0.61 to 2.9 m). In the center of Pit B, waste depths ranged from 2.5 to 5.0 ft (0.76 to 1.52 m), and in the eastern portion of Pit B, waste depths ranged from 3.5 to 5.0 ft (1.07 to 1.52 m) [WCC, 1987]. Two samples of the material were also collected for chemical analysis of volatile and semivolatile organic compounds. Results of this analysis demonstrated that the waste material in the western end of Pit B contained relatively high concentrations of volatile organics (6.4 to 53 ppm total ethylbenzene, benzene, toluene, and xylenes) and semivolatile organics (24 to 54 ppm various PAHs) when compared to the waste material located at the eastern end of Pit B [WCC, 1987]. Phenolics were also noted at the western end of Pit B [WCC, 1987]. The volume of wastes in Pit B was estimated as 1,900 yd^3 (1,453 m^3) [WCC, 1987]; however, some of the cross sections used to estimate the volume in the RI were only comprised of two measuring locations, [WCC, 1987].

As a part of the FFS currently being performed by GeoSyntec, evaluation of the waste characteristics in Pit B was required. During the FFS, it became evident that insufficient chemical data existed to characterize the waste and complete waste profile sheets. Waste profile sheets are required to make decisions regarding the technical and regulatory feasibility of off-site disposal and to obtain cost quotations for disposal. GeoSyntec therefore conducted a supplemental site investigation at Pit B. As a component of the supplemental site investigation, four waste samples were collected and analyzed for total and TCLP metals, total and TCLP semivolatile organics, total and TCLP volatile organics, reactive cyanide, reactive sulfide, corrosivity, and ignitability [GeoSyntec, 1996b]. Results of the supplemental site investigation indicated that, at one sampling location, benzene was present in concentrations above the TCLP limit in the eastern end of Pit B. The concentrations of benzene at that location were above the Universal Treatment Standard (UTS) for benzene as stated in 40 CFR 268.48 [GeoSyntec, 1996b]. The TM-EDA/PB also noted that based on totals analyses, other constituents were present in excess of UTS criteria; however, because these constituents were not present at levels making the waste characteristically hazardous (i.e., above the TCLP criteria), it was concluded that the UTS levels do not apply unless characteristic levels were exceeded for some other hazardous waste characteristic (which was not the case here, as is demonstrated below) [GeoSyntec, 1996b]. GeoSyntec performed a statistical evaluation of available TCLP data to evaluate whether the total waste mass would be classified as characteristically hazardous. This statistical evaluation was performed in accordance with procedures presented in SW-846 [USEPA, 1986]. Based on the statistical evaluation, it was concluded that additional data points were needed to make conclusions regarding the hazardous characteristics of the total waste mass.

HLA estimated the volume of the waste and affected materials in Pit B to be approximately 12,000 yd^3 (9,175 m^3). Based on a review of the RI data and the likely geometry of Pit B, this estimate appears to be high. In summary, Pit B volume estimates computed during the RI appear to be more reasonable. However, because some of the cross sections used in the RI to develop these estimates were based on only two probing locations, the waste depths measured during the RI needed to be verified so that the accuracy of the Pit B volume estimates in the RI report could be confirmed.

2. STUDY OBJECTIVE

As defined in the FFSR for the Bailey Superfund Site, Pit B is considered a "hot spot" due to the viscous, tarry waste located in this area [GeoSyntec, 1996c]. Because of this designation, it should be handled differently from the remainder of the site with respect to remedy selection and implementation. Due to the somewhat limited information previously available for the chemical analyses of waste samples, it was decided to obtain additional chemical data to ensure that an appropriate remedy is applied to Pit B. The objective of this study was to: (i) verify the waste volume estimates presented in the RI report; (ii) characterize the waste; and (iii) evaluate the available process options for Pit B.

3. SAMPLING AND TESTING PROCEDURES

3.1 Sample Collection

On 6 and 7 March 1996, samples of the waste were collected from 19 locations within Pit B. In addition, samples of the soil beneath the waste were collected from six of the 19 locations. Sampling locations were selected to provide approximate uniform coverage of the area, and to provide representative samples in terms of visual consistency. The sample locations are shown on Figure 2.

Due to difficult site conditions, some field modifications to the planned sampling methodology were necessary. These modifications were discussed with USEPA oversight personnel prior to implementation. The waste samples were collected in the following manner:

- 4-in. (10-cm) diameter PVC pipes were advanced through the waste and into the underlying soil stratum;
- 2-in. (5-cm) diameter PVC pipes were used to make a modified bailer that could be lowered into the waste column within the 4-in. (10-cm) diameter PVC pipes;
- the dedicated PVC bailer was used to collect the waste samples from each sample location;
- the waste samples were poured from the bailers into labeled plastic Zip-Lock bags so that the samples could be placed in the laboratory containers more easily (due to the sticky and tarry nature of the waste); 4-oz (120-ml) vials used for the total volatile organic analyses were filled at the sample locations and not from the samples placed in the plastic Zip-Lock bags in order to reduce the potential for volatilization of volatile constituents; and

- waste that was temporarily stored in Zip-Lock bags was transferred to laboratory containers shortly after sampling; the containers were then labeled, placed in plastic bubble bags, and stored on ice in an insulated cooler for transportation to the analytical laboratory.

Samples were shipped under chain-of-custody protocols to an analytical laboratory for the analyses presented in Section 3.2 of this document. Chemical analyses were performed by Law Engineering and Environmental Services National Laboratories, Pensacola Branch, of Pensacola, Florida.

After the collection of the waste samples, the depth to the bottom of the waste was measured. To perform this measurement, the waste was removed from within the 4-in. (10-cm) diameter PVC pipes with the modified bailer and an auger. The location of the soil/waste interface was confirmed by augering several inches into the underlying soils. The depth to the waste/soil interface was measured from the top of the PVC pipes. The elevations of the ground surface and top of the 4-in. (10-cm) diameter PVC pipes at each sample location were surveyed so that a thickness of waste could be calculated for each sample location. At five of the 19 sample locations, samples of soil beneath the waste were collected for geotechnical engineering testing. These tests were performed by GeoSyntec Geomechanics and Environmental Laboratory in Atlanta, Georgia.

3.1.1 Sample Identification

Each sample was given a unique identification number that corresponds to the sample locations shown on Figure 2. Where duplicates were taken, the sample designations were followed with a "D." For example, a sample with an identification code of A2-D would indicate a duplicate waste sample taken at sample location A2.

3.1.2 Sample Descriptions

Table 1 provides descriptions of waste and soil samples collected during the Pit B pre-design study activities. This description is limited to a physical description of the sample.

3.2 Sample Analysis and Testing

3.2.1 Chemical Analyses of Waste Samples

An analysis summary for the waste samples collected in support of the pre-design study at Pit B is presented in Table 2. The following analyses were performed on one or more waste samples (method numbers are in parentheses):

- TCLP metals (SW 1311/6010);
- TCLP volatile organics (SW 1311/8260);
- TCLP semivolatile organics (SW 1311/8270);
- corrosivity by pH (SW 9045);
- ignitability (EPA Method 1010);
- paint filter (SW 9095);
- reactive cyanide and sulfide (SW-846, Chapter 7);
- TAL inorganics;
    - TAL Metals (ICP and GFAA - SW 6010 and SW 7000);
    - Mercury (CVAA - SW 7470/SW 7471); and
    - Cyanide (SW 9010).
- TCL volatile organics (SW 8260); and

- TCL semivolatile organics (SW 8270).

3.2.2 Laboratory Testing of Soil Samples

The geotechnical engineering tests performed on the soil samples from beneath the waste in Pit B are also presented in Table 2. The following analyses were performed on one or more samples (method numbers are in parentheses):

- moisture content (ASTM D 2216);
- percent passing No. 200 U.S. standard sieve (ASTM D 1140);
- Atterberg limits (ASTM D 4318);
- soil classification (ASTM D 2487); and
- hydraulic conductivity (ASTM D 5087).

The results of these laboratory tests are presented in Section 4.4 of this document.

4. INVESTIGATION AND TESTING RESULTS

4.1 Summary of Analytical Results of Waste Samples

Table 3 presents the results of chemical analyses performed on the waste samples collected from Pit B. Only analytes for which at least one positive detection was noted are presented therein. The application of the "J" flag to denote estimated values has only been applied by the analytical laboratory, Law Engineering and Environmental Services National Laboratories, to identify quantified values less than the sample-specific sample quantitation limit (SQL), yet greater than the instrument detection limit (IDL) or method detection limit (MDL), as appropriate to the method under consideration. The analytical laboratory data are presented in Appendix B. An evaluation of the practical significance of the data is presented in Section 4.2 of this document.

As a component of the Target Compound List analyses of organic compounds, tentatively identified compounds (TICs) were identified. TICs are not identified by comparison to analytical primary standards. Rather, they are identified by library searches against known retention times (gas chromatography) or ion abundance and intensity (mass spectroscopy). Consequently, the identification and quantitation of these compounds is grossly estimated. These data are not presented in Table 3, but are presented in Appendix B. A brief discussion of these compounds follows.

The TICs identified for the Pit B samples were detected in both the volatile (SW 8260) and semivolatile (SW 8270) analytical suites. With respect to volatile organic compounds, TICs identified included cycloalkanes, cycloalkenes, various alkylated benzenes, naphthalene, linear alkanes, furans, and benzofurans. Depending on the sample analyzed, concentrations of each constituent ranged from not detected to 300 ppm per constituent (including benzofuran). With respect to semivolatile organic compounds, several TICs were detected. The only readily identifiable semivolatile TICs were nonane and methylated heptadecane, and a hydroxymethylnaphthalene compound. Like the volatile TICs, concentrations of these compounds varied with the sample analyzed, from not detected to 15,000 ppm. None of the TICs detected are regulated under 40 CFR 261.4, their identification and quantitation are both uncertain, and their detection does not impact the findings of the TCLP analysis or the identification and quantification of target compounds.

4.2 Evaluation of Analytical Results of Waste Samples

The following section describes the procedure used to evaluate the results of chemical analyses performed on waste samples from Pit B.

4.2.1 TCLP Extraction

Only two of the analytes (benzene and 1,2-dichloroethane) exhibited exceedances of TCLP criteria in discrete samples. The results for these two analytes were subjected to statistical analysis as outlined in SW-846 [USEPA, 1986]. Neither data set was normally distributed at 95 percent confidence. 1,2-dichloroethane was square root normally distributed at 95 percent confidence; benzene was not however. Both data sets were lognormally distributed at 95 percent confidence. The 80 percent UCLs for benzene and 1,2-dichloroethane, expressed as logarithms, were 5.8312 ln (µg/L) and 5.12466 ln (µg/L), respectively. These were compared to the logged value of the regulatory limit of each (500 (µg/L); 6.21 ln (µg/L) for each analyte). Since the 80 percent UCL of the logged values of benzene and 1,2-dichloroethane were both less than the logged TCLP value for benzene and 1,2-dichloroethane, these analytes are not present in the Pit B waste material at a characteristically hazardous concentration.

The positive hits in the TCLP extract were compared to regulatory criteria in 40 CFR 261.4. The positive detections in the TCLP extract above regulatory criteria are summarized in Table 4 for both the current study and for the supplemental site investigation conducted at Pit B by GeoSyntec [GeoSyntec, 1996b]. Analytes for which at least one value exceeded the regulatory criteria (TCLP limits) were the subject of further statistical analysis, the purpose of which was to evaluate whether the analyte in question was present in the Pit B waste material at a hazardous concentration. This statistical analysis is recommended in Chapter 9 of SW-846 [USEPA, 1986]; the statistical procedures used are summarized below.

The data for the Pit B pre-design study were pooled with those of the supplemental site investigation for Pit B [GeoSyntec, 1996b]. Duplicate values were discarded; this practice is not mentioned in the SW-846 guidance; however, to include duplicate values in the analysis would introduce a dependency to the data which will skew its interpretation. Results reported as "not detected" were replaced with one-half the sample-specific sample quantitation limit (SQL) prior to statistical analysis; this procedure is not specifically recommended in SW-846; however, the USEPA has recommended its use previously for similar statistical calculations on environmental media [USEPA, 1992a; USEPA, 1992b]. The raw data were tested for normality using the Shapiro Wilk W Test [Shapiro and Wilk, 1965]; SW-846 does not recommend this procedure for testing normality, only to look for "obvious non-normality" by an evaluation of the ratio of the data set mean to its variance; however, the USEPA has recommended the use of the Shapiro Wilk normality test for other statistical testing procedures [USEPA, 1992b], and GeoSyntec therefore assumes that it is acceptable to USEPA for this purpose.

If the raw data tested normal, then an 80 percent upper confidence limit (UCL) was placed on the data set, and this value was compared to the regulatory threshold for the analyte of interest. If the 80 percent UCL exceeded this value, then the waste code associated with the analyte under consideration was assigned to the Pit B material. If the data did not test normal, SW-846 recommends using certain mathematical transformations, specifically the square root transformation if the mean of the raw data set was greater than its variance or the arcsin transformation if the mean of the raw data set was less than its variance [USEPA, 1986]. SW-846 also instructs the user to review a statistical text book on the use of the arcsin transformation [USEPA, 1986]. The arcsin transformation requires the data be expressed on a proportional basis, and is usually only applied to categorical or binomial data that can be approximated by an arcsin function and subsequently estimated using a normal approximation [Ott, 1984]. This is clearly not the case for the current study as the data collected are random and continuous, rather than discrete. Therefore, the arcsin transformation was not employed, however, the square root transformation was employed, as was the natural logarithmic transformation. The natural logarithmic transformation has been recommended for use by USEPA previously [USEPA, 1992a; USEPA 1992b], and GeoSyntec therefore assumes that it is acceptable to USEPA for this purpose.

Regardless of the transformation used, the 80 percent UCL was constructed on the transformed data and compared to the equivalently transformed regulatory limit. The calculations used in support of this analysis are presented in Appendix A. Based on the results of this statistical evaluation, no analytes are present in the TCLP extract of the Pit B waste material at a characteristically hazardous concentration.

4.2.2 Total Analyses

A summary of totals analyses for analytes that exhibit positive detection is presented in Table 3.

As stated above, based on the results of the statistical evaluation, no analytes are present in the TCLP extract of the Pit B waste material at a characteristically hazardous concentration. Therefore, evaluation of totals analyses with respect to regulatory levels is not necessary for the purpose of evaluating whether the waste is characteristically hazardous.

4.2.3 Miscellaneous Analyses

Table 3 also presents a summary of the results of miscellaneous analyses performed on the Pit B waste samples. These analyses include reactivity, corrosivity, moisture content, ignitability and paint filter testing. The results of these analyses indicate the presence of reactive sulfides at levels that exceed 500 mg/kg (i.e., the current USEPA interim guidance level for total releasable sulfides). This level is currently used by landfill facilities, including the BFI Anahuac facility, as the waste acceptance criterion for reactive sulfides. Also, the majority of samples failed the paint filter test.

Based on these results, waste conditioning will be required in order to deactivate reactive sulfides (if present in the waste) and improve materials handling properties if the waste is to be disposed at an off-site industrial waste landfill.

Based on the results of the reactive sulfides analyses, GeoSyntec conducted a waste conditioning study for Pit B waste. The results of this study are presented in Appendix D. The objectives of the study were to evaluate: (i) the likely source of the reactive sulfides that identified in the collected samples of Pit B waste; and (ii) the types of waste conditioning required to reduce the levels of reactive sulfide (if present) in the waste. The study indicates that the reactive sulfides likely originate from the thin layer of marsh sediment that is located immediately above the waste material in Pit B. This finding is based on the following:

- the bulk samples collected for the waste conditioning study did not contain reactive sulfides in excess of the threshold value of 500 mg/kg; the bulk samples did not contain marsh sediments, whereas the samples having reactive sulfides were comprised of a waste and sediment mixture;

- a water sample collected from Pit B did not contain reactive sulfides (i.e., reactive sulfide levels were less than the 50 mg/kg detection limit); and

- a marsh sediment sample collected from Pit B contained reactive sulfides at a concentration of 800 mg/kg wet weight; 5,700 mg/kg dry weight.

Based on these results, it is likely that neither the water nor the waste will contain reactive sulfides above the threshold value. It is likely that the marsh sediments originated from the decay of vegetative matter in Pit B. Also, it is likely that reactive sulfides in the marsh sediment will oxidize under aerobic conditions following the dewatering of Pit B, thus rendering reactive sulfides a non-issue.

Since the pre-treatment concentrations of reactive sulfides in the waste conditioning study samples were very low, the study was inconclusive with respect to the potential effectiveness of the conditioning agents at deactivating reactive sulfides. However, since the addition of lime appeared to improve the materials handling characteristics and may have had an effect on reducing reactive sulfides, it is recommended that a waste conditioning pilot test be conducted to further evaluate the effectiveness of waste conditioning.

4.3 Waste Thickness Investigation Results

The thickness of the waste within Pit B ranges from approximately 1.9 ft (0.6 m) to 5.5 ft (1.7 m). Based on a review of the data collected during the Pit B PDS, the thickness of the waste varies from location to location, with no pronounced trend being established. For adjacent sample locations, the waste thickness may vary up to 2 to 3 ft (0.6 to 0.9 m). Based on the waste thickness data and the lateral extent of Pit B, the quantity of waste within Pit B has been estimated at 4,000 yd^3 (3,060 m^3) However, the actual volume could be greater or less than this value because of the high degree of variability of the thickness of the waste.

4.4 Geotechnical Testing Results of Soil Samples

The data report for the laboratory test on soil samples collected from beneath Pit B is included as Appendix C of this document. As shown in Table 1 of Appendix C, the soil samples had the following characteristics:

- moisture content (ASTM D 2216): 26.9 to 46.1 percent with an average of 36.3 percent;
- percent passing No. 200 U.S. standard sieve (ASTM D 1140): 69.6 to 97.8 percent with an average of 87.9 percent;
- Atterberg limits (ASTM D 4318): liquid limit – 42 to 62 percent with an average of 50.2 percent; plastic limit – 19 to 29 percent with an average of 22.8 percent; plasticity index – 20 to 36 percent with an average of 27.4 percent;
- soil classification (ASTM D 2487): CL, CH, and ML; and
- hydraulic conductivity (ASTM D 5085): 9×10^{-9} to 1.2×10^{08} cm/sec.

5. IDENTIFICATION AND SCREENING OF PROCESS OPTIONS

5.1 Introduction

As presented in Section 7 of the FFSR, the following process options will be considered for Pit B and other isolated areas of the site containing sludge-like wastes:

- sheet pile walls;
- in-situ solidification to an alternative performance criteria or method-based specification; and
- off-site disposal.

If sheet pile walls and/or in-situ solidification were implemented for the remediation within Pit B, a lightweight composite cap would be constructed over the area. For off-site disposal, pre-disposal solidification of the excavated material will most likely be necessary or required based on the physical properties (e.g., moisture content, viscosity) of the excavated material. Pre-disposal solidification of the waste within Pit B could occur before or after the waste is transported to the disposal facility, depending on the facility that is selected.

This section presents the screening of process options listed above. The process options for Pit B were screened using criteria established in the "*Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*" [USEPA, 1988b] and "*Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*" [USEPA, 1993a]. These criteria are:

Effectiveness. Effectiveness is evaluated based on the ability of the process option to meet the remedial action objectives. Both short-term and long-term effectiveness are evaluated within this criterion. Short-term effectiveness considers the length of time required to implement the process option and any adverse effects on human health or the environment during the construction or implementation period. Long-term effectiveness considers the ability of the process option to limit contaminant migration following the construction period and includes a relative assessment of the reduction in contaminant toxicity, mobility, or volume provided by the process option.

Implementability. This criterion evaluates both the technical and administrative implementability of the process option. Technical implementability considers the ability to construct and reliably operate and maintain the process option and to monitor the process option after implementation. Administrative implementability considers: (i) the ability to obtain necessary regulatory approvals; (ii) the type and availability of necessary treatment, storage, and disposal services; and (iii) the availability of necessary equipment and technical expertise.

Cost. This criterion evaluates the capital, operations, and maintenance costs of the process option. This criterion is used to identify whether the cost of the process option is grossly disproportionate to other process options when compared to the level of effectiveness achieved. In accordance with USEPA guidance, detailed cost estimates are not prepared at this stage of the screening process. Rather, the process option is evaluated based on experience and judgment and in terms of cost versus effectiveness.

State and community acceptance were not considered during the screening process.

5.2 Process Option 1: Sheet Pile Walls

5.2.1 Description

A sheet pile wall is considered a potential enhancement to a capping remedy, especially in areas where tarry and viscous wastes, such as those in Pit B, are present. If necessary, a sheet pile wall would be installed along all or a portion of the perimeter of Pit B to: (i) control lateral migration of waste constituents by providing a low hydraulic conductivity barrier through which ground-water flow velocities are reduced when compared to flow velocities under the current hydrogeological regime; (ii) contain consolidation water; and (iii) provide physical containment of viscous, tarry wastes.

To implement this process option, steel sheet piles would be driven into the subsurface by a pile hammer or hydraulic press. The primary advantages of sheet piling are that excavation of contaminated materials is not required for their installation and the wall would provide physical containment of the viscous, tarry waste within Pit B. The effectiveness of a sheet pile subsurface barrier is dependent on the effectiveness of the interlocking joints between adjacent sheet piles. Joint sealing methods are available for reducing the leakage between adjacent sheets. Due to the importance of minimizing the potential for leakage through joints, extra effort in improving the joint seal is often warranted. Principal disadvantages of sheet piling are the high cost, uncertainty in verifying the quality of the joint seals, and potential for corrosion of the steel sheet piles.

5.2.2 Screening

The screening comments for the sheet pile wall process option is provided below.

Effectiveness

Short term. The sheet pile wall described above provides a potentially effective means of physically containing and reducing the mobility of the waste. Since excavation of waste material would not be required for the installation of a sheet pile wall, the potential for exposure of workers and local residents to site contaminants during construction would be relatively low; thus increasing the short-term effectiveness of this process option. The construction of a sheet pile wall would probably not disturb the integrity of the dikes surrounding Pit B.

Long term. The selection of a sheet pile wall or other type of vertical subsurface barrier process option is largely dependent on the degree of reduction in hydraulic conductivity required, and the physical and chemical properties of the constituents of concern. Sheet pile walls are effective, proven technologies for reducing the mobility of constituents, but do not result in reduction of toxicity or volume of the waste. Based on the hydrogeological conditions at the Bailey Superfund Site and the hydraulic conductivities of sheet pile walls, a sheet pile wall would not be effective at reducing constituent migration unless effective joint sealing methods are implemented. However, it would provide physical containment of the viscous, tarry waste in Pit B. It is also noted that the steel sheet piles may corrode over time, thereby reducing the long-term effectiveness of this process option.

Implementability

Technical. It is technically feasible to construct a sheet pile wall around Pit B. However, potential site constraints (i.e., limited access, location of waste, size of dikes, and proximity of the North Marsh Area to the waste) and the stability of the dikes would need to be evaluated during design.

Administrative. Sheet pile walls are a proven process option that have been used for the containment of a variety of waste materials. However, a sheet pile wall was not included in the ROD or the original remedial design.

Cost

A sheet pile wall is considered a moderately cost effective process option for the physical containment of the waste within Pit B, especially if structural strength is required.

5.2.3 Economic Considerations

The process options for sheet pile walls and in-situ solidification contain certain common elements that are considered baseline costs. These include construction of the lightweight composite cap and related site improvements. The order of magnitude construction cost estimate for the installation of the sheet pile wall around Pit B and construction of a lightweight cap over the area is estimated at $570,000.

5.2.4 Other Considerations

The following considerations are also relevant to the implementation of Process Option 1:

- although the waste would be contained and capped, the waste material would remain on-site;
- the portion of the cap over Pit B would require long-term maintenance; and
- it is unlikely that this alternative could be executed during the 1996 spring/summer construction season, thereby causing the waste to remain in Pit B until the 1996/1997 winter construction season.

5.3 Process Option 2: In-Situ Solidification

5.3.1 Description

5.3.1.1 Overview

In-situ solidification refers to the mechanical mixing of wastes and affected soils in place with a solidification admixture. Typical admixtures may include cement, bentonite, lime kiln dust, and/or flyash. The admixtures can be introduced either as a dry powder or slurry. In-situ solidification has been traditionally used for immobilizing inorganic compounds such as metals in contaminated soils and sludges and for improving the physical/mechanical properties of these materials.

In-situ solidification is typically performed to achieve one or both of the following objectives:

- to reduce the mobility of leachable constituents in wastes and affected soils; and
- to improve the strength of the waste and affected soils.

The original remedial design included a requirement to solidify the waste to *"reduce the mobility of the waste and provide strength to support a clay cap"* [USEPA, 1988a]. Treatability testing results presented the FS report and remedial design documents show that solidification produced a reduction in the leachability of certain waste constituents. The waste solidification component of the original remedial design included specified performance criteria for unconfined compressive strength and hydraulic conductivity for the solidified material. The performance criterion for unconfined compressive strength was established at 25 psi (172 kPa). The hydraulic conductivity performance criterion for the solidified waste was 1 x 10^{-6} cm/s.

In-situ solidification activities were performed on waste in the southern portion of the East Dike Area of the Bailey Superfund Site during 1993 and 1994. During initial attempts to solidify waste in the East Dike Area, Chem Waste encountered difficulties in achieving the specified physical and hydraulic characteristics (i.e., unconfined compressive strength and hydraulic conductivity) for the solidified waste. As a result of these difficulties, the remedial activities eventually ceased in early 1994. Based on this experience, if solidification is implemented, the performance criteria should be modified at a minimum.

5.3.1.2 Alternative Performance Criteria

This process option would involve in-situ solidification of the waste to alternative performance criteria that would be developed based on field testing. Based on a review of work performed during the original RA, the unconfined compressive strength criterion would be achievable if the sampling method is modified. The elimination of the hydraulic conductivity criterion would allow for broader application of the in-situ solidification process option. If this process option were selected for Pit B, the strength performance criterion would be evaluated during remedial design and established at a value that is both achievable and appropriate with respect to other remedy components.

5.3.1.3 Method-Based Specification

For this process option, the waste would be solidified based on a specified mixing method and rate of application for the solidification admixture. The physical characteristics of the solidified waste, would not be the basis for acceptance of a completed area, but would be evaluated at either laboratory or pilot scale, and empirically correlated to the specified construction method. Quality assurance would be based on monitoring the equipment, methods, and admixture application rates to make sure they were in accordance with the technical specifications. This approach would be advantageous since it would not require extensive sampling and testing during construction operations, and would therefore eliminate the uncertainties of correlating discrete performance testing to in-situ conditions.

If this process option were selected for Pit B, the appropriate method would be evaluated during the remedial design based on existing information and supplemental information gathered during the FFS and subsequent design activities.

5.3.2 Screening

The in-situ solidification process options presented above are very similar except for the technical criteria that would be included in the construction specifications. The process options were evaluated according to the five previously-described criteria. A summary of the criteria evaluations for the in-situ solidification process options is included below.

Effectiveness

Short term. The short-term effectiveness of these process options is considered to be moderate since the treatment activities are performed in-situ and would involve some waste disturbance. However, contaminant exposure to precipitation, stormwater, and the atmosphere could occur. In addition, the implementation period for these process options can be lengthy.

Long term. If these process options can be successfully implemented, they typically are effective at reducing contaminant mobility. However, the solidification process does not reduce the toxicity of the constituents, and results in an increase in the total volume of the waste material.

Implementability

Technical. In-situ solidification of the waste within Pit B with alternative performance criteria or a method-based specification could be achieved, but it would also be expensive, time consuming, and may result in a significant volume increase due to the quantity of solidification reagent needed to solidify the waste. In-situ solidification could potentially be implemented in Pit B which contains sludge-like waste and very little to no co-disposed waste (industrial waste and MSW), provided that the performance criteria in the original remedial design were modified to include alternate performance criteria or a method-based specification. In-situ solidification of the waste in Pit B would be difficult due to the oily, tarry, and organic nature of the waste. However, based on treatability studies performed for the North Marsh Area waste, which is reported to have originated from Pit B and has similar physical characteristics, solidification of the Pit B waste should be technically implementable.

Administrative. The selected remedy in the ROD includes in-situ solidification of the waste, but does not provide the performance criteria (unconfined compressive strength or hydraulic conductivity criteria) for the solidified waste. The specified performance criteria was established by HLA during remedial design. Since the performance criteria are not part of the ROD, a modification to the performance criteria to include alternate performance criteria or a method-based specification could be performed without having to change or modify the ROD, and thus decrease potential administrative difficulties.

Cost

These process options are relatively expensive based on the cost estimates to implement the original remedial design. However, cost savings could be achieved if alternate performance criteria or a method-based specification were implemented.

5.3.3 Economic Considerations

Costs for Process Option 2 include in-situ solidification of the waste within Pit B and the construction of a lightweight cap over the area. Based on an evaluation of the performance of the original remedial design, and an evaluation of typical construction costs to construct the lightweight cap, an order of magnitude construction cost of $660,000 has been estimated.

5.3.4 Other Considerations

The following considerations are also relevant to the implementation of Process Option 2:

- although the waste would be stabilized and capped, the waste material would remain on-site;
- since a cap will be constructed over the solidified waste, long-term maintenance requirements and costs for the cap would be incurred for this area; and
- it is unlikely that this alternative could be designed and constructed in time for the 1996 spring/summer construction season, thereby allowing the waste to remain in Pit B until the 1996/1997 winter construction season.

5.4 Process Option 3: Off-Site Disposal

5.4.1 Identification of Off-Site Disposal Facilities

Waste currently being removed form the North Marsh Area is being transported to the Browning-Ferris Industries (BFI) disposal facility in Anahuac, Texas. In the past, GeoSyntec has also contacted several other disposal facilities located in proximity to the Bailey Superfund Site. These include: the BFI facility near Beaumont, Texas; the Chem Waste facility in Port Arthur, Texas; and the Chem Waste facility in Lake Charles, Louisiana.

Based on information gathered from the disposal facilities, the nature of the waste within Pit B, and the ongoing removal activities of the North Marsh Area waste, the BFI facility located in Anahuac, Texas, appears to be the most viable candidate for off-site disposal of the Pit B waste. This facility is a Class I industrial waste landfill (non-hazardous) and is located approximately 60 miles (100 km) from the site. In addition, the BFI-Anahuac facility has the capability to solidify the waste at their facility prior to disposal in the landfill. Therefore, the waste could be solidified off-site, if required, provided that the excavated Pit B waste can be properly conditioned, handled, and transported.

For planning purposes, the BFI-Anahuac facility is considered as "preferred" for disposal of the Pit B waste. The criteria used to establish this preference are:

- the evaluation of the Pit B waste characteristics, presented in this document;
- experience gained during the on-going North Marsh Area waste removal work;
- waste acceptance criteria;
- distance from the site;
- disposal costs; and
- the facility's capability to perform waste solidification.

5.4.2 Description

This process option involves the use of mechanical excavation equipment to condition the waste, excavate, and load wastes for off-site disposal at a permitted Class I industrial waste landfill. Ex-situ solidification of the excavated waste would be performed at the disposal facility following transportation, if required, to meet regulatory requirements and/or landfill disposal requirements.

The objective of off-site disposal is to remove the source (waste and affected soils) from the Pit B area of the site. Excavated materials would be disposed and managed at a permitted commercial facility; thereby, reducing contaminant mobility.

Effectiveness

<u>Short term.</u> If uncontrolled, excavation of the waste would increase the potential for contaminant exposure for humans, wildlife, precipitation, and stormwater runoff. The construction activities associated with this process option would result in the need for the following measures to limit human exposure and adverse environmental impacts: (i) dust suppression; (ii) equipment and personnel decontamination facilities; (iii) use of personnel protection equipment; and (iv) stormwater control. Excavation dewatering

may also be required, and potentially contaminated ground water and stormwater runoff would need to be properly managed.

Long term. The long-term effectiveness of this process option for the Pit B waste is considered good. The toxicity, mobility, and volume of on-site constituents would be significantly reduced if the waste were excavated and placed in an off-site secure landfill. However, the toxicity and volume of the waste material would ultimately remain unchanged by relocating it. The mobility of the waste material would be reduced by placing it in a Class I industrial waste landfill. Wastes would be solidified, if required, prior to placement in the landfill to facilitate handling, and this would further reduce the mobility of contaminants.

Implementability

Technical. The waste material could be difficult to excavate and load into trucks due to: (i) the composition and consistency of the waste; and (ii) difficulties with controlling seepage into excavations. Waste conditioning may be required to: (i) deactivate any reactive sulfides that exist in the waste above the threshold limit of 500 mg/kg; and (ii) improve materials handling characteristics. Air emissions during excavation, if not adequately managed, could pose a risk to workers at the site. However, these concerns can be addressed by implementing adequate engineering controls, as evidenced by the success of the waste removal activities currently being performed in the North Marsh Area. The approach of only removing isolated areas of waste (e.g., Pit B waste) is consistent with "*Presumptive Remedies for CERCLA Municipal Landfill Sites*" [USEPA, 1993b], which recognizes the difficulties associated with large-scale removal of MSW and establishes containment as a presumptive remedy for CERCLA municipal landfill sites, not off-site disposal.

Administrative. If this technology were selected, the necessary regulatory approvals and requirements could be met with a moderate amount of effort. The removal and off-site disposal of waste from isolated areas is consistent with USEPA presumptive remedies. Permitted disposal facilities for the disposal of the waste are available in the general proximity of the site. The disposal facility may need to perform some level of solidification of the waste prior to disposal. A new waste code will be required prior to disposal (this is obtained through TNRCC).

Cost

Off-site disposal of wastes within Pit B is considered cost effective because: (i) the volume of the waste would be approximately 4,000 yd^3 (3,060 m^3); (ii) the waste could be conditioned in place then removed and transported without significant difficulty; and (iii) other areas of the site could be remediated using other cost effective process options.

5.4.3 Economic Considerations

Costs for Process Option 3 include: (i) conditioning of the waste in place; (ii) removal of the waste from Pit B; (iii) transportation of the waste to the BFI waste disposal facility located in Anahuac, Texas; and (iv) disposal fees. The order of magnitude construction cost for this process option is estimated at $1,200,000, based on the cost of performing the remediation of the North Marsh Area waste. This cost is based on the following assumptions:

- 4,000 yd^3 (3,060 m^3) of material (in-place volume);
- waste conditioning (in place) will be required;
- the waste may be disposed at BFI's Class I industrial waste landfill (non-hazardous) located in Anahuac, Texas;
- pre-disposal solidification of the excavated waste will occur at the disposal facility; and
- the area will be backfilled with clean fill following waste removal.

5.4.4 Other Considerations

The following considerations are also relevant for the implementation of Process Option 3:

- the Pit B waste will be removed from the site, therefore long-term maintenance requirements and costs specifically for the Pit B waste may not be necessary;

- this alternative could be executed during the 1996 construction season as part of the remediation of the North Marsh Area; and

- since the wastes can be solidified off site, the time required for on-site activities may be reduced.

6. CONCLUSIONS

Process Option 3 is considered the most desirable disposal option following an evaluation of technical, economic, and regulatory considerations and USEPA's nine-point criteria for evaluating remedial alternatives. Future activities for implementing Process Option 3 include obtaining necessary regulatory approvals, conducting a waste conditioning pilot test to evaluate the waste conditioning requirements, and the development of a detailed scope of work/specifications.

The results of a bench scale study that was performed to evaluate waste conditioning requirements is presented as Appendix D.

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TABLES

TABLE 1
SAMPLE DESCRIPTIONS
PIT B PRE-DESIGN STUDY
BAILEY SUPERFUND SITE
ORANGE COUNTY, TEXAS

Sample Identification	Sample Type	Description
A1	Waste	Black tarry waste
A1	Soil/Sediment	Grey silty clay
A2	Waste	Black tarry waste
A2D	Waste	Black tarry waste
A3	Waste	Black tarry waste
A4	Waste	Black tarry waste
AB1	Waste	Black tarry waste with rubber crumb
B1	Waste	Black elastic, tarry waste
B2	Waste	Black tarry waste with rubber crumb
B3	Waste	Black tarry waste with rubber crumb
C1	Waste	Black tarry waste with rubber crumb
C2	Waste	Black tarry waste
D1	Waste	Black tarry waste with rubber crumb
D1	Soil/Sediment	Grey soft clay
D2	Waste	Black tarry waste with rubber crumb
D2	Soil/Sediment	Light brown to grey soft clay
D3	Waste	Black tarry waste with rubber crumb
E1	Waste	Black tarry waste with rubber crumb
E1	Soil/Sediment	Grey silty clay
E2	Waste	Black tarry waste with rubber crumb
F1	Waste	Black tarry waste with rubber crumb
F2	Waste	Black tarry waste with rubber crumb
F2	Soil/Sediment	Reddish brown to grey clay
F3	Waste	Black elastic, tarry waste with rubber crumb
F4	Waste	Black tarry waste with possible rubber crumb

TABLE 2
SUMMARY OF ANALYSES AND TESTS PERFORMED
PIT B PRE-DESIGN STUDY
BAILEY SUPERFUND SITE
ORANGE COUNTY, TEXAS

WASTE SAMPLES

Sample Identification	TCLP Volatiles	TCLP Semivolatiles	TCLP Metals	Ignitability	Corrosivity (pH)	Reactivity (Cyanide/ Sulfide)	Paint Filter	TCL Volatiles	TCL Semivolatiles	TAL Metals	Cyanide
A1	X	X	X	X	X	X	X				
A2	X	X	X	X	X	X	X				
A2D	X	X	X		X						
A3	X	X	X	X	X	X	X	X	X	X	X
A4	X	X	X	X	X	X	X				
AB1	X	X	X	X	X	X	X				
B1	X	X	X	X	X	X	X	X	X	X	X
B2	X	X	X	X	X	X	X				
B3	X	X	X	X	X	X	X				
C1	X	X	X	X	X	X	X				
C2	X	X	X	X	X	X	X	X	X	X	X
D1	X	X	X	X	X	X	X				
D2	X	X	X	X	X	X	X	X	X	X	X
D3	X	X	X	X	X	X	X				
E1	X	X	X	X	X	X	X	X	X	X	X
E2	X	X	X	X	X	X	X				
F1	X	X	X	X	X	X	X				
F2	X	X	X	X	X	X	X	X	X	X	X
F3	X	X	X	X	X	X	X				
F4	X	X	X	X	X	X	X				

SOIL SAMPLES

Sample Identification	Moisture Content	Percent Passing No. 200 US Standard Sieve	Atterberg Limits	Soil Classification	Hydraulic Conductivity
A1	X	X	X	X	
B2	X	X	X	X	X
D1	X	X	X	X	X
E1	X	X	X	X	
F2	X	X	X	X	

TABLE 3
POSITIVE DETECTIONS
PIT B PRE-DESIGN STUDY
BAILEY SUPERFUND SITE
ORANGE COUNTY, TEXAS

		Sample Identification											
Compound	**Units**	**A1**	**A2**	**A2D**	**A3**	**A4**	**AB1**	**B1**	**B2**	**B3**	**C1**	**C2**	**D1**
TCLP EXTRACTION													
Volatile Organics, SW 8260													
1,2-Dichloroethane	ug/L	502	474	410	872	3.29J	1 68J	440	165	<50	238	812	<50
Benzene	ug/L	268	333	310	465	47.3	15 8	277	200	25 4J	222	445	<50
Chlorobenzene	ug/L	<50	<50	<50	<50	<5	1 32J	<50	<50	<50	<50	<50	<50
Semivolatile Organics, SW 8270													
2-Methylphenol	ug/L	<1,000	<1,000	<1,000	<100	<100	29.3J	<510	<100	<100	<100	<500	<102
3-Methylphenol	ug/L	<1,000	232JCE	232JCE	<100	<100	30 8JCE	425JCE	<100	<100	53.3JCE	<500	<102
4-Methylphenol	ug/L	408J	232JCE	232JCE	<100	<100	30 8JCE	425JCE	<100	<100	53 3JCE	<500	<102
Metals, SW 6010													
Arsenic	ug/L	<500	<500	<500	<500	<500	<500	24.0J	46.0J	<500	<500	32 0J	<500
Barium	ug/L	1,080	911	966	455	1,060	1,480	1,110	995	1,000	994	726	1,070
Chromium	ug/L	<50	18 0J	17.0J	9 00J	11 0J	<50	9.00J	<50	<50	<50	<50	<50
Lead	ug/L	31.0J	38 0J	54 0J	<120	27 0J	33 0J	47 0J	40.0J	40 0J	26.0J	19 0J	21 0J
TOTAL ANALYSES													
Volatile Organics, SW 8260													
1,2-Dichloroethane	ug/kg	NA	NA	NA	57,900	NA	NA	8,800	NA	NA	NA	26,900	NA
Tetrachloroethene	ug/kg	NA	NA	NA	<12,500	NA	NA	<625	NA	NA	NA	<1250	NA
Benzene	ug/kg	NA	NA	NA	59,700	NA	NA	8,800	NA	NA	NA	24,700	NA
Ethylbenzene	ug/kg	NA	NA	NA	118,000	NA	NA	16,700	NA	NA	NA	37,100	NA
Styrene	ug/kg	NA	NA	NA	131,000	NA	NA	13,700	NA	NA	NA	44,000	NA
Toluene	ug/kg	NA	NA	NA	38,800	NA	NA	5,230	NA	NA	NA	14,800	NA
Xylenes (Total)	ug/kg	NA	NA	NA	63,600	NA	NA	9,220	NA	NA	NA	20,400	NA
Semivolatile Organics, SW 8270													
2-Methylnaphthalene	ug/kg	NA	NA	NA	<3,200,000	NA	NA	<4,750,000	NA	NA	NA	<3,060,000	NA
Fluorene	ug/kg	NA	NA	NA	73,600J	NA	NA	<4,750,000	NA	NA	NA	<3,060,000	NA
Naphthalene	ug/kg	NA	NA	NA	355,000J	NA	NA	28,700J	NA	NA	NA	30,500J	NA
Phenanthrene	ug/kg	NA	NA	NA	<3,200,000	NA	NA	<4,750,000	NA	NA	NA	<3,060,000	NA
Metals, SW 6010													
Aluminum	mg/kg	NA	NA	NA	652	NA	NA	3,060	NA	NA	NA	1,490	NA
Antimony	mg/kg	NA	NA	NA	<27 8	NA	NA	3.75J	NA	NA	NA	<31 2	NA
Barium	mg/kg	NA	NA	NA	51 6	NA	NA	201	NA	NA	NA	65 1	NA
Calcium	mg/kg	NA	NA	NA	490	NA	NA	1,250	NA	NA	NA	896	NA
Chromium	mg/kg	NA	NA	NA	36 0	NA	NA	53 2	NA	NA	NA	35.5	NA
Cobalt	mg/kg	NA	NA	NA	1 78J	NA	NA	2 62J	NA	NA	NA	2 38J	NA
Copper	mg/kg	NA	NA	NA	28 0	NA	NA	75 9	NA	NA	NA	60 9	NA
Iron	mg/kg	NA	NA	NA	2,170	NA	NA	9,860	NA	NA	NA	4,780	NA
Magnesium	mg/kg	NA	NA	NA	127	NA	NA	473	NA	NA	NA	505	NA
Manganese	mg/kg	NA	NA	NA	11 8	NA	NA	58 1	NA	NA	NA	41 8	NA
Nickel	mg/kg	NA	NA	NA	3 55J	NA	NA	6.50	NA	NA	NA	7.25	NA
Potassium	mg/kg	NA	NA	NA	64.7J	NA	NA	196	NA	NA	NA	433	NA
Silver	mg/kg	NA	NA	NA	1 22J	NA	NA	<6.25	NA	NA	NA	<6.25	NA
Sodium	mg/kg	NA	NA	NA	488	NA	NA	960	NA	NA	NA	1,220	NA
Vanadium	mg/kg	NA	NA	NA	2 44J	NA	NA	5.00J	NA	NA	NA	3 88J	NA
Zinc	mg/kg	NA	NA	NA	52 1	NA	NA	204	NA	NA	NA	73 5	NA

TABLE 3 (continued)
POSITIVE DETECTIONS
PIT B PRE-DESIGN STUDY
BAILEY SUPERFUND SITE
ORANGE COUNTY, TEXAS

		Sample Identification							
Compound	Units	D2	D3	E1	E2	F1	F2	F3	F4
TCLP EXTRACTION									
Volatile Organics, SW 8260									
1,2-Dichloroethane	ug/L	22 1J	<50	57 6	45 8J	113	475	235	476
Benzene	ug/L	79 3	87 9	1,350	1,130	1,910	1,780	1,440	689
Chlorobenzene	ug/L	<50	<50	<50	<50	<50	<50	<50	<50
Semivolatile Organics, SW 8270									
2-Methylphenol	ug/L	29 5J	<101	20.9J	<100	36 7J	<500	42 3J	104
3-Methylphenol	ug/L	103CE	52 0JCE	87.1JCE	69 6JCE	103CE	372JCE	184CE	245CE
4-Methylphenol	ug/L	103CE	52 0JCE	87 1JCE	69 6JCE	103CE	372JCE	184CE	245CE
Metals, SW 6010									
Arsenic	ug/L	<500	30 0J	<500	<500	<500	<500	37 0J	47.0J
Barium	ug/L	1,670	1,440	1,480	1,910	3,100	925	899	626
Chromium	ug/L	<50	<50	19 0J	<50	30.0J	16.0J	<50	<50
Lead	ug/L	42 0J	57.0J	36 0J	38 0J	54.0J	106J	55 0J	110J
TOTAL ANALYSES									
Volatile Organics, SW 8260									
1,2-Dichloroethane	ug/kg	585J	NA	1220J	NA	NA	10,000	NA	NA
Tetrachloroethene	ug/kg	<625	NA	<2500	NA	NA	2,120J	NA	NA
Benzene	ug/kg	2,460	NA	33,100	NA	NA	65,600	NA	NA
Ethylbenzene	ug/kg	9,570	NA	84,700	NA	NA	61,100	NA	NA
Styrene	ug/kg	1,740	NA	6,560	NA	NA	18,700	NA	NA
Toluene	ug/kg	1,790	NA	25,600	NA	NA	49,200	NA	NA
Xylenes (Total)	ug/kg	4,320	NA	47,100	NA	NA	74,400	NA	NA
Semivolatile Organics, SW 8270									
2-Methylnaphthalene	ug/kg	<3,490,000	NA	<4,690,000	NA	NA	75,800J	NA	NA
Fluorene	ug/kg	<3,490,000	NA	<4,690,000	NA	NA	18,300J	NA	NA
Naphthalene	ug/kg	<3,490,000	NA	507,000J	NA	NA	73,200J	NA	NA
Phenanthrene	ug/kg	<3,490,000	NA	<4,690,000	NA	NA	35,000J	NA	NA
Metals, SW 6010									
Aluminum	mg/kg	9,000	NA	8,640	NA	NA	3,020	NA	NA
Antimony	mg/kg	<67 5	NA	11 3J	NA	NA	5 38J	NA	NA
Barium	mg/kg	623	NA	654	NA	NA	2,960	NA	NA
Calcium	mg/kg	5,300	NA	12,500	NA	NA	5,980	NA	NA
Chromium	mg/kg	146	NA	170	NA	NA	103	NA	NA
Cobalt	mg/kg	14 6	NA	10.8J	NA	NA	12 1	NA	NA
Copper	mg/kg	142	NA	115	NA	NA	165	NA	NA
Iron	mg/kg	21,600	NA	35,800	NA	NA	36,700	NA	NA
Magnesium	mg/kg	2,250	NA	2,220	NA	NA	1,040	NA	NA
Manganese	mg/kg	183	NA	225	NA	NA	176	NA	NA
Nickel	mg/kg	18 4	NA	14 8	NA	NA	20 7	NA	NA
Potassium	mg/kg	994	NA	983	NA	NA	430	NA	NA
Silver	mg/kg	<13.5	NA	<13 4	NA	NA	1 34J	NA	NA
Sodium	mg/kg	4,910	NA	3,350	NA	NA	2,600	NA	NA
Vanadium	mg/kg	17 3	NA	16 9	NA	NA	15 0	NA	NA
Zinc	mg/kg	698	NA	1,400	NA	NA	323	NA	NA

TABLE 3 (continued)
POSITIVE DETECTIONS
PIT B PRE-DESIGN STUDY
BAILEY SUPERFUND SITE
ORANGE COUNTY, TEXAS

		Sample Identification											
Compound	**Units**	**A1**	**A2**	**A2D**	**A3**	**A4**	**AB1**	**B1**	**B2**	**B3**	**C1**	**C2**	**D1**
Metals, SW 7000 Series													
Arsenic (SW 7060)	mg/kg	NA	NA	NA	1	NA	NA	2	NA	NA	NA	1	NA
Lead (SW 7421)	mg/kg	NA	NA	NA	24	NA	NA	90	NA	NA	NA	25	NA
Selenium (SW 7740)	mg/kg	NA	NA	NA	<0.4930	NA	NA	0.212J	NA	NA	NA	<0.64	NA
Thallium (SW 7841)	mg/kg	NA	NA	NA	<0.1970	NA	NA	0	NA	NA	NA	<0.256	NA
MISCELLANEOUS ANALYSES													
Reactive Cyanide (SW 846)	mg/kg (ww)	<200	<200	NA	<200	<200	<200	<200	<200	<200	<200	<200	<200
Reactive Sulfide (SW 846)	mg/kg (ww)	<400	950	NA	1,800	<400	580	580	<400	1,800	1,500	<400	690
Solid pH (SW 9045)	NA	4.59	4.58	4.75	4.04	6.62	6.48	4.98	5.53	6.79	5.63	4.45	6.59
Moisture Content (ASTM D 2216)	Percent	41	59	61	31	74	44	45	63	73	69	44	44
Ignitability W/S (EPA 1010)	°F	NF<200	NF<200	NA	NF<200	NF<200	NF<200	NF<200	NF<200	NF<200	NF<200	NF<200	NF<200
Paint Filter Test (SW 9095)	Pass/Fail	Fail	Fail	NA	Pass	Fail	Fail	Fail	Fail	Fail	Fail	Fail	Fail

NOTES:
NA. *Not analyzed*
J. Estimated concentation, reported value is less than the SQL
CE· Coelution of peaks occurred.

TABLE 3 (continued)
POSITIVE DETECTIONS
PIT B PRE-DESIGN STUDY
BAILEY SUPERFUND SITE
ORANGE COUNTY, TEXAS

		Sample Identification							
Compound	Units	D2	D3	E1	E2	F1	F2	F3	F4
Metals, SW 7000 Series									
Arsenic (SW 7060)	mg/kg	5	NA	7	NA	NA	23	NA	NA
Lead (SW 7421)	mg/kg	208	NA	208	NA	NA	832	NA	NA
Selenium (SW 7740)	mg/kg	0 274J	NA	<1 32	NA	NA	0.521J	NA	NA
Thallium (SW 7841)	mg/kg	0.352J	NA	0.347J	NA	NA	0.234J	NA	NA
MISCELLANEOUS ANALYSES									
Reactive Cyanide (SW 846)	mg/kg (ww)	<200	<200	<200	<200	<200	<200	<200	<200
Reactive Sulfide (SW 846)	mg/kg (ww)	1,600	1,300	1,200	880	1,300	700	<400	<400
Solid pH (SW 9045)	NA	6 17	6.68	6.56	6 69	5 40	5 06	5 52	5 38
Moisture Content (ASTM D 2216)	Percent	73	75	72	68	59	62	50	52
Ignitability W/S (EPA 1010)	°F	NF<200	NF<200	NF<200	NF<200	NF<200	NF<200	NF<200	NF<200
Paint Filter Test (SW 9095)	Pass/Fail	Fail	Fail	Fail	Fail	Fail	Fail	Fail	Fail

NOTES:
NA. Not analyzed
J. Estimated concentation; reported value is less than the SQ
CE. Coelution of peaks occurred

TABLE 4
POSITIVE DETECTIONS AND TCLP LIMITS
PIT B PRE-DESIGN STUDY
BAILEY SUPERFUND SITE
ORANGE COUNTY, TEXAS

	Analyte TCLP Limit (ug/L)												
Sample Identification	Arsenic 5,000	Barium 100,000	Chromium 5,000	Cadmium 1,000	Lead 5,000	Benzene 500	1,2-Dichloroethane 500	Chlorobenzene 100,000	Trichloroethene 500	4-Methyl Phenol 200,000	2-Methyl Phenol 200,000	3-Methyl Phenol 200,000	Total Cresols 200,000
A1	<500	1,080	<50	<10	31	268	$\boxed{502}$	<50	<50	408	<1,000	<1,000	408
A2	<500	911	18	<10	38	333	474	<50	<50	232	<100	232	464
A3	<500	455	9	<10	<120	465	$\boxed{872}$	<50	<50	<100	<100	<100	<100
A4	<500	1,060	11	<10	27	47	3	<50	<50	<100	<100	<100	<100
AB1	<500	1,480	<50	<10	33	16	2	1	<50	31	29	31	62
B1	24	1,110	9	<10	47	277	440	<50	<50	43	<100	<100	43
B2	46	995	<50	<10	40	200	165	<50	<50	<100	<100	<100	<100
B3	<500	1,000	<50	<10	40	25	<50	<50	<50	<100	<100	<100	<100
C1	<500	994	<50	<10	26	222	238	<50	<50	53	<100	53	107
C2	32	726	<50	<10	19	445	$\boxed{812}$	<50	<50	<500	<500	<500	<500
D1	<500	1,070	<50	<10	21	<50	<50	<50	<50	<100	<100	<100	<100
D2	<500	1,670	<50	<10	42	79	22	<50	<50	103	30	<100	103
D3	30	1,440	<50	<10	57	88	<50	<50	<50	52	<100	<100	52
E1	<500	1,480	19	<10	36	$\boxed{1,350}$	58	<50	<50	87	21	<100	87
E2	<500	1,910	<50	<10	38	$\boxed{1,130}$	46	<50	<50	70	<100	<100	70
F1	<500	3,100	30	<10	54	$\boxed{1,910}$	113	<50	<50	103	37	<100	103
F2	<500	925	16	<10	106	$\boxed{1,780}$	475	<50	<50	372	<500	<500	372
F3	37	899	<50	<10	55	$\boxed{1,440}$	235	<50	<50	184	42	<100	184
F4	47	626	<50	<10	110	25	<50	<50	<50	245	104	<100	245
GPBW1 (a)	30	3,100	28	<1	<15	$\boxed{1,800}$	100	<10	<50	NA	NA	NA	140
GPBW2 (a)	40	2,900	80	2	<15	70	$\boxed{<2,500}$	<10	<50	NA	NA	NA	176
GPBW3 (a)	<30	1,100	4	<1	<15	150	100	<10	<50	NA	NA	NA	200
GPBW4 (a)	<30	1,800	3	<1	19	440	420	<10	43	NA	NA	NA	<100

NOTES:

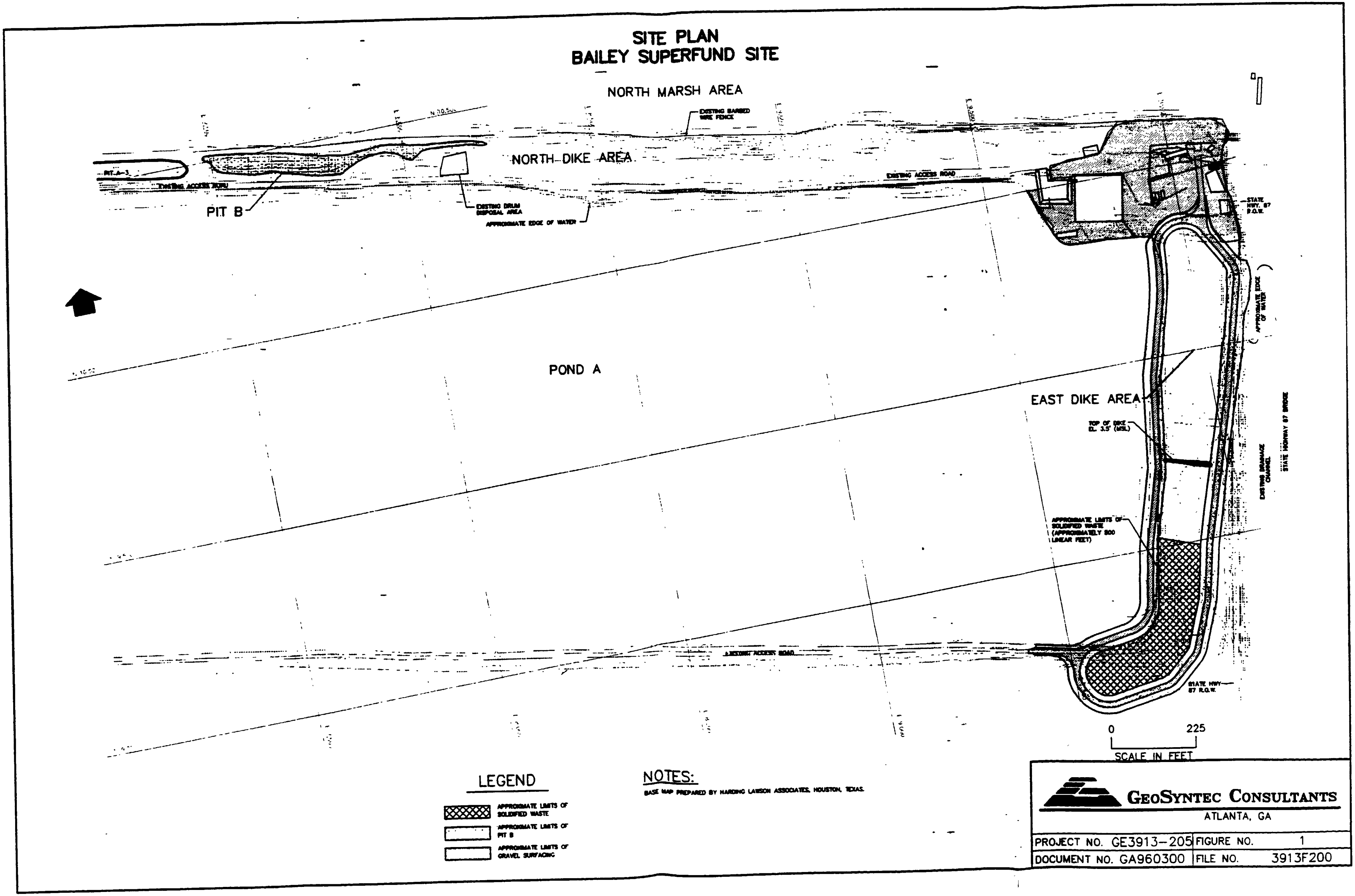
TCLP results reported in ug/L.

$\boxed{\quad}$: indicates an exceedance of TCLP criteria.

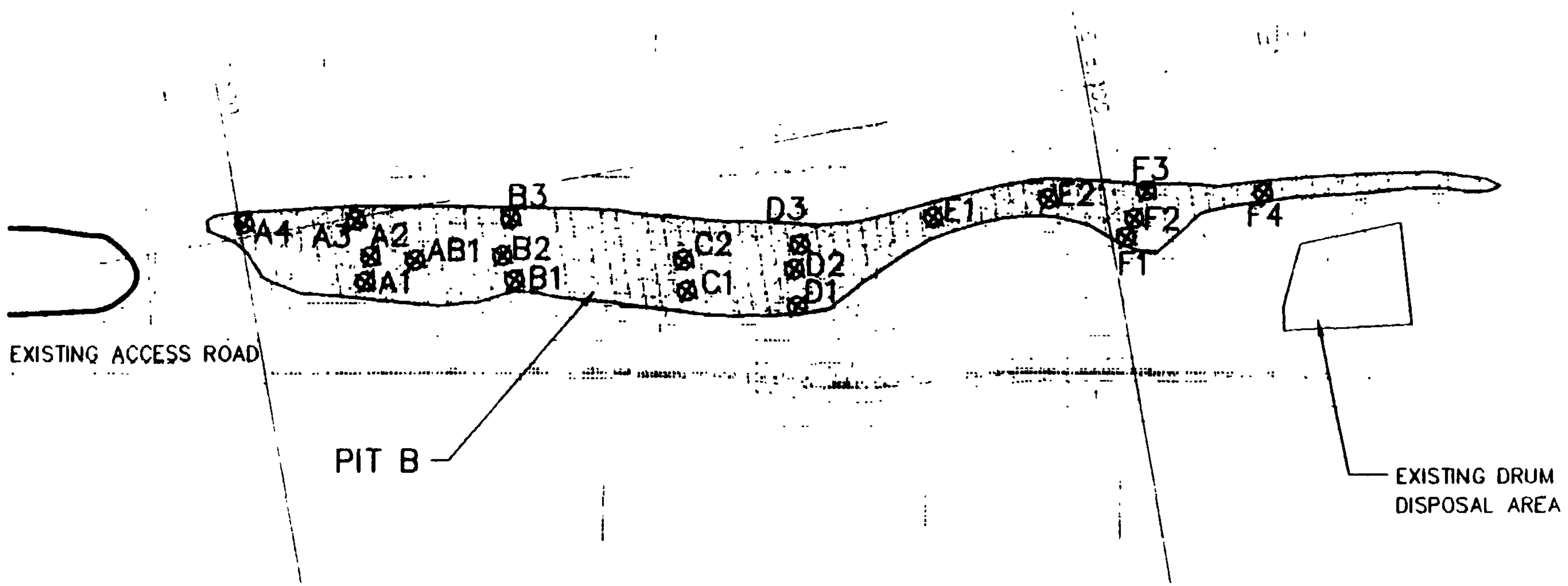
NA: Not analyzed separately.

(a): Data collected from Supplemental Pit B Site Investigation [GeoSyntec, 1996b].

FIGURES


SITE PLAN
BAILEY SUPERFUND SITE
NORTH MARSH AREA
EXISTING BARBED WIRE FENCE
NORTH DIKE AREA
PIT A-3
EXISTING ACCESS ROAD
PIT B
EXISTING DRUM DISPOSAL AREA
APPROXIMATE EDGE OF WATER
EXISTING ACCESS ROAD
STATE HWY. 87 R.O.W.
APPROXIMATE EDGE OF WATER
POND A
EAST DIKE AREA
TOP OF DIKE EL. 3.5' (MSL)
EXISTING DRAINAGE CHANNEL
STATE HIGHWAY 87 BRIDGE
APPROXIMATE LIMITS OF SOLIDIFIED WASTE (APPROXIMATELY 500 LINEAR FEET)
EXISTING ACCESS ROAD
STATE HWY 87 R.O.W.
0
225
SCALE IN FEET
LEGEND
APPROXIMATE LIMITS OF SOLIDIFIED WASTE
APPROXIMATE LIMITS OF PIT B
APPROXIMATE LIMITS OF GRAVEL SURFACING
NOTES:
BASE MAP PREPARED BY HARDING LAWSON ASSOCIATES, HOUSTON, TEXAS.
GEOSYNTEC CONSULTANTS
ATLANTA, GA
PROJECT NO. GE3913-205
FIGURE NO. 1
DOCUMENT NO. GA960300
FILE NO. 3913F200

PIT B SAMPLE LOCATIONS
PIT B PRE-DESIGN STUDY
BAILEY SUPERFUND SITE



LEGEND

⊠A4 DESIGNATION AND LOCATION OF SAMPLES

APPROXIMATE LIMITS OF PIT B

NOTE:

BASE MAP PREPARED BY HARDING LAWSON ASSOCIATES, HOUSTON, TEXAS.

0 100
SCALE IN FEET

GEOSYNTEC CONSULTANTS
ATLANTA, GEORGIA

FIGURE NO.	2
PROJECT NO.	GE3913-205
DOCUMENT NO.	GA960300
FILE NO.	3913F201

APPENDIX A

STATISTICAL CALCULATIONS

Shapiro-Wilk Normality Test Procedures:

The Shapiro-Wilk W test is an effective test of whether the underlying distribution being tested is normally distributed. Data normality is a prerequisite to the computation of certain types of statistical intervals (e.g., parametric upper confidence limits (UCLs)) and to the execution of certain statistical tests (e.g., parametric analysis of variance). A discussion of this testing procedure follows. In the Shapiro-Wilk Test, the following hypothesis is tested [Gilbert, 1987]:

H_0 : The population has a normal distribution
H_1 : The population does not have a normal distribution

If H_0 is rejected, then H_1 is accepted and the population is concluded to not be normally distributed. If H_0 cannot be rejected, then there is no reason to doubt that the population is normally distributed, given the data set tested. To make this determination, a *W* test statistic was computed. The denominator, *d*, of this statistic was computed using the formula:

$$d = \sum_{i=1}^{n} (x_i - \bar{x})^2$$

where
x_i = each individual datum and
$\bar{x}$ = the mean of the data set
n = the total number of points in the data set

Then the data were ordered from largest to smallest to obtain sample order statistics. For example:

$$x_1 \leq x_2 \leq \ldots \leq x_n$$

Then, *k* was computed by the following formula:

$$k = n/2 \text{ if } n \text{ is even}$$

$$k = (n\text{-}1)/2 \text{ if } n \text{ is odd}$$

The coefficients a_1, a_2, a_3,..., a_n were then determined from tabulated values provided in Gilbert [1987], and the W test statistic was computed by the formula:

$$W = \frac{1}{d}\left[\sum_{i=1}^{k} a_i\left(x_{[n-i+1]} - x_{[i]}\right)\right]^2$$

If the W statistic was less than the W quantile at α=0.05 (95% confidence) provided in Gilbert [1987], or if the P value of the test was less than α=0.05, then H_0 was rejected, and the population was concluded to be not normal. If the W statistic exceeded the W quantile at α=0.05 (95% confidence), or if the P value of the test was greater than α=0.05, then H_0 was not rejected, and there was no reason to doubt the normality of the population. The P value of this test is the probability associated with the computed W statistic. If it is less than the significance level selected for the test, this is an indicator that the null hypothesis should be rejected. If is not less than the significance level selected for the test, then this is an indicator that the null hypothesis is probably appropriate and should be retained.

UCL Computation:

UCLs are computed by the following formula [USEPA, 1986]:

$$UCL = \bar{x} + t_{0.20,(n-1)} \times \frac{s}{\sqrt{n}}$$

where $\bar{x}$ = the data set mean
s = the data set standard deviation
n = the number of points in the data set
$t_{0.20,(n-1)}$=Student's t statistic at 80% confidence and $(n-1)$ degrees of freedom

Benzene:

SAM	VALUE	LOGS	SQRT
A1	268	5.59099	16.3707
A2	333	5.80814	18.2483
A3	465	6.14204	21.5639
A4	47.3	3.85651	6.8775
AB1	15.8	2.76001	3.9749
B1	277	5.62402	16.6433
B2	200	5.29832	14.1421
B3	25.4	3.23475	5.0398
C1	222	5.40268	14.8997
C2	445	6.09807	21.095
D1	25	3.21888	5
D2	79.3	4.37324	8.9051
D3	87.9	4.4762	9.3755
E1	1350	7.20786	36.7423
E2	1130	7.02997	33.6155
F1	1910	7.55486	43.7035
F2	1780	7.48437	42.19
F3	1440	7.2724	37.9473
F4	25.4	3.23475	5.0398
GPBW1	1800	7.49554	42.4264
GPBW2	70	4.2485	8.3666
GPBW3	150	5.01064	12.2474
GPBW4	440	6.08677	20.9762

<u>**Normality Test (Raw Data):**</u>

$W_{stat} = 0.759782 \quad W_{crit}\,(95\%) = 0.914$

Reject H_0, conclude raw data are not normally distributed.

Normality Test (Square Root):

$W_{stat} = 0.873875 \quad W_{crit}\,(95\%) = 0.914$

Reject H_0, conclude square root transformed data are not normally distributed.

Normality Test (Logarithms):

$W_{stat} = 0.937795 \quad W_{crit}\,(95\%) = 0.914$

Cannot reject H_0, no reason to doubt the normality of the log-transformed data.

UCL Computation

The UCLs will be calculated based on the logged data.

$$\bar{x}_{\log} = 5.413456$$
$$s_{\log} = 1.529266$$
$$n = 23$$
$$t_{0.80,23} = 1.321$$

$$UCL = \bar{x}_{\log} + t_{0.80,23}\frac{s_{\log}}{\sqrt{n}}$$

$$UCL = 5.413456 + 1.321 \times \frac{1.529266}{\sqrt{23}} = 5.8312$$

The TCLP value for benzene is 500 µg/L. The natural logarithm of this value is 6.21.

The UCL for benzene is less than the logarithm of the TCLP value; therefore benzene is not present at hazardous concentrations in the Pit B waste.

1,2-Dichloroethane

SAM	VAL2	LOGS	SQRT
A1	502	6.2186	22.4054
A2	474	6.16121	21.7715
A3	872	6.77079	29.5296
A4	3.29	1.19089	1.8138
AB1	1.68	0.51879	1.2961
B1	440	6.08677	20.9762
B2	165	5.10595	12.8452
B3	25	3.21888	5
C1	238	5.47227	15.4272
C2	812	6.6995	28.4956
D1	25	3.21888	5
D2	22.1	3.09558	4.7011
D3	25	3.21888	5
E1	57.6	4.05352	7.5895
E2	45.8	3.82428	6.7676
F1	113	4.72739	10.6301
F2	475	6.16331	21.7945
F3	235	5.45959	15.3297
F4	25	3.21888	5
GPBW1	100	4.60517	10
GPBW2	1250	7.1309	35.3553
GPBW3	100	4.60517	10
GPBW4	420	6.04025	20.4939

Normality Test (Raw Data):

$W_{stat} = 0.797951$ W_{crit} (95%) = 0.914

Reject H_0, conclude raw data are not normally distributed.

Normality Test (Square Root):

$W_{stat} = 0.922571$ $W_{crit}(95\%) = 0.914$

Cannot reject H_0, no reason to doubt the normality of the square root-transformed data.

Normality Test (Logarithms):

$W_{stat} = 0.9334102$ $W_{crit}(95\%) = 0.914$

Cannot reject H_0, no reason to doubt the normality of the log-transformed data.

UCL Computation

The UCLs will be calculated based on the logged data because they exhibit the most strongly normal character (larger W_{stat} value)

$$\bar{x}_{\log} = 4.643715$$
$$s_{\log} = 1.759542$$
$$n = 23$$
$$t_{0.80,23} = 1.321$$

$$UCL = \bar{x}_{\log} + t_{0.80,23} \frac{s_{\log}}{\sqrt{n}}$$

$$UCL = 4.643715 + 1.321 \times \frac{1.759542}{\sqrt{23}} = 5.12466$$

The TCLP value for 1,2-dichloroethane is 500 µg/L. The natural logarithm of this value is 6.21.

The UCL for 1,2-dichloroethane is less than the logarithm of the TCLP value; therefore 1,2- dichloroethane is not present at hazardous concentrations in the Pit B waste.

References

Gilbert, 1987. *Statistical Methods For Environmental Pollution Monitoring.* New York, Van Nostrand Reinhold.

USEPA, 1986 *Test Methods for Evaluating Solid Waste, SW 846, 3rd edition,* November, 1986.

APPENDIX C

LABORATORY TESTING RESULTS

GeoSyntec Consultants

Geomechanics and Environmental Laboratory
5775 Peachtree Dunwoody Road • Suite 10D
Atlanta, Georgia 30342 • USA
Tel. (404) 705-9500 • Fax (404) 705-9300

4 April 1996

Mr. R. Neil Davies, P.E.
GeoSyntec Consultants
1100 Lake Hearn Drive, Suite 200
Atlanta, Georgia 30342

Subject: Final Report - Laboratory Test Results
Bailey Superfund Site
Pit B Pre-Design Study

Dear Mr. Davies:

GeoSyntec Consultants (GeoSyntec) Geomechanics and Environmental Laboratory in Atlanta, Georgia, is pleased to present the attached final test results (Table 1 and Figures 1 through 5) for the above referenced project. A blank shown on the table or the figures indicates that the test was not performed, the parameter is not applicable, or that the test resulted in insufficient data to report the designated parameter. Attachment A presents the general information pertinent to the testing program, and the policy of GeoSyntec regarding the limitations and use of the test results.

The Geomechanics and Environmental Laboratory appreciates the opportunity to provide testing services for this project. Should you have any questions regarding the attached test results or if you require additional information, please do not hesitate to contact either of the undersigned.

Sincerely,

James M. Stalcup

James M. Stalcup, E.I.T.
Assistant Program Manager
Special Testing

Nader S. Rad

Nader S. Rad, Ph.D., P.E.
Laboratory Director

Attachment

GE3913/GEL96035

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

BAILEY SUPERFUND SITE
PIT B PRE-DESIGN STUDY

Client Sample ID	Lab Sample No.	As-Received Moisture Content (%)	Grain Size: Percent Passing #200 Sieve ASTM D 1140 (%)	Grain Size: ASTM D 422 Sieve Figure No.	Grain Size: ASTM D 422 Hydrom. Figure No.	Atterberg Limits ASTM D 4318: LL (%)	Atterberg Limits ASTM D 4318: PL (%)	Atterberg Limits ASTM D 4318: PI (-)	Soil Classification ASTM D 2487	Compaction ASTM D 698: Max. Dry Unit Weight (pcf)	Compaction ASTM D 698: Optimum Moisture Content (%)	Compaction ASTM D 698: Figure No.	Hydraulic Conductivity ASTM D 5084: Test Specimen Initial Conditions: Dry Unit Weight (pcf)	Hydraulic Conductivity ASTM D 5084: Test Specimen Initial Conditions: Moisture Content (%)	Hydraulic Conductivity ASTM D 5084: Test Specimen Initial Conditions: Consolidation Pressure (psi)	Hydraulic Conductivity ASTM D 5084: Hydraulic Conductivity (cm/s)
A1	E96C05	27.1	80.5	1		45	19	26	CL - Lean Clay with Sand							
B2	E96C06	41.8	69.6	2		42	20	22	CL - Sandy Lean Clay							
B2	E96C07	30.8											85.8	30.8	5.0	9.0E-9
D1	E96C08	46.1	97.8	3		53	20	33	CH - Fat Clay							
D1	E96C09	38.6											83.7	38.6	5.0	1.2E-8
E1	E96C10	42.9	95.8	4		62	26	36	CH - Fat Clay							
F2	E96C11	26.9	95.7	5		49	29	20	ML - Silt							

GEO SYNTEC CONSULTANTS
Geomechanics and Environmental Laboratory
Atlanta, Georgia

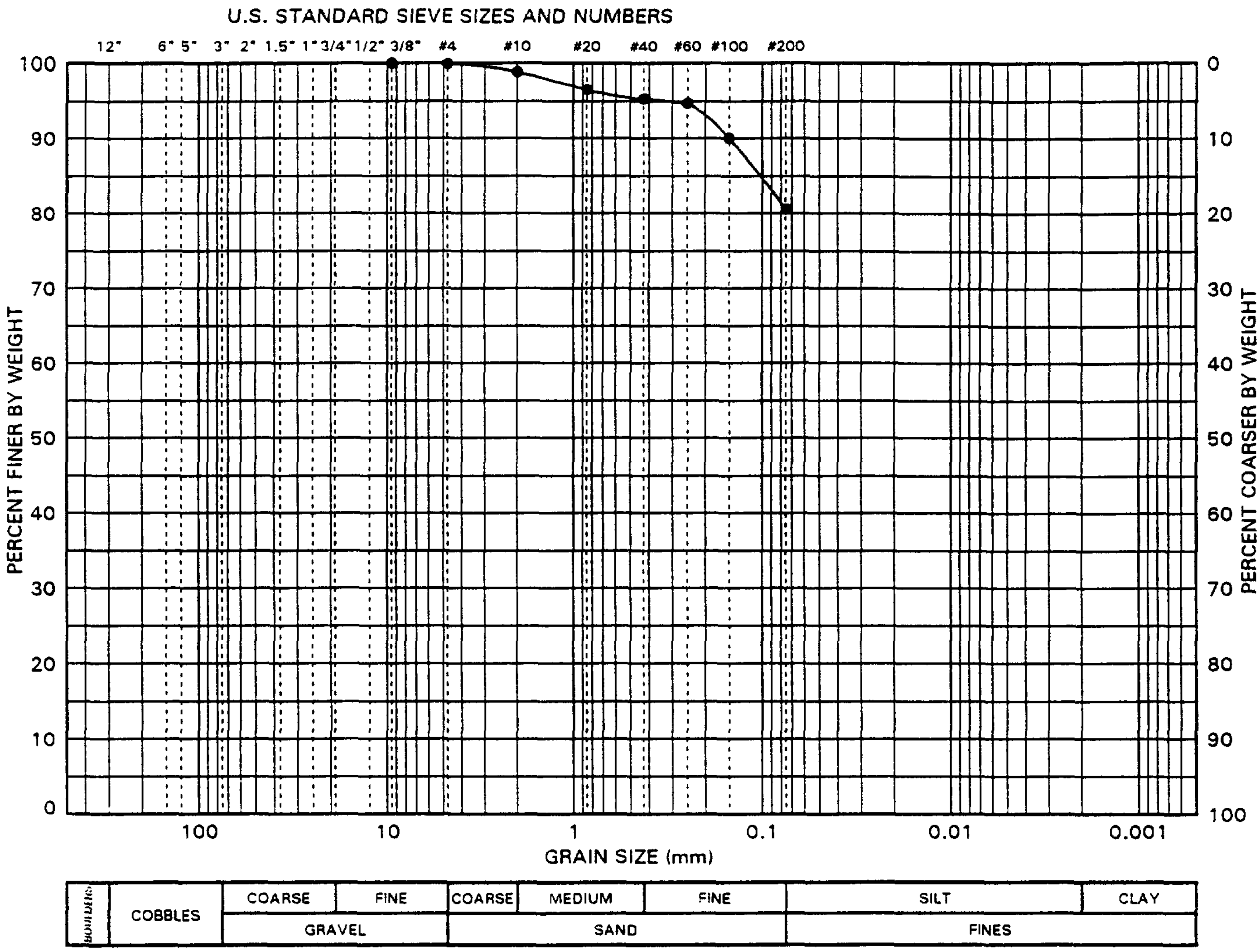
FIGURE 1

PROJECT: BAILEY SITE
PROJECT NO.: GE3913
DOCUMENT NO.: GEL96035

GS FORM: 4PS2 04/02/96

PARTICLE SIZE DISTRIBUTION AND PHYSICAL PROPERTIES

ASTM C 136, D 422, D 2487 D 3042 AND D 4318



SITE SAMPLE ID	A1	LIQUID LIMIT (%)	45	GRAVEL (%)	0.1
LAB. SAMPLE NO.	E96C05	PLASTIC LIMIT (%)	19	SAND (%)	19.4
SAMPLE DEPTH (ft)		PLASTICITY INDEX	26	FINES (%)	80.5
SOIL CLASSIFICATION:				SILT (%)	
CL - Lean Clay with Sand				CLAY(%)	
				COEFF. UNIFORMITY (Cu)	
				COEFF. CURVATURE (Cc)	

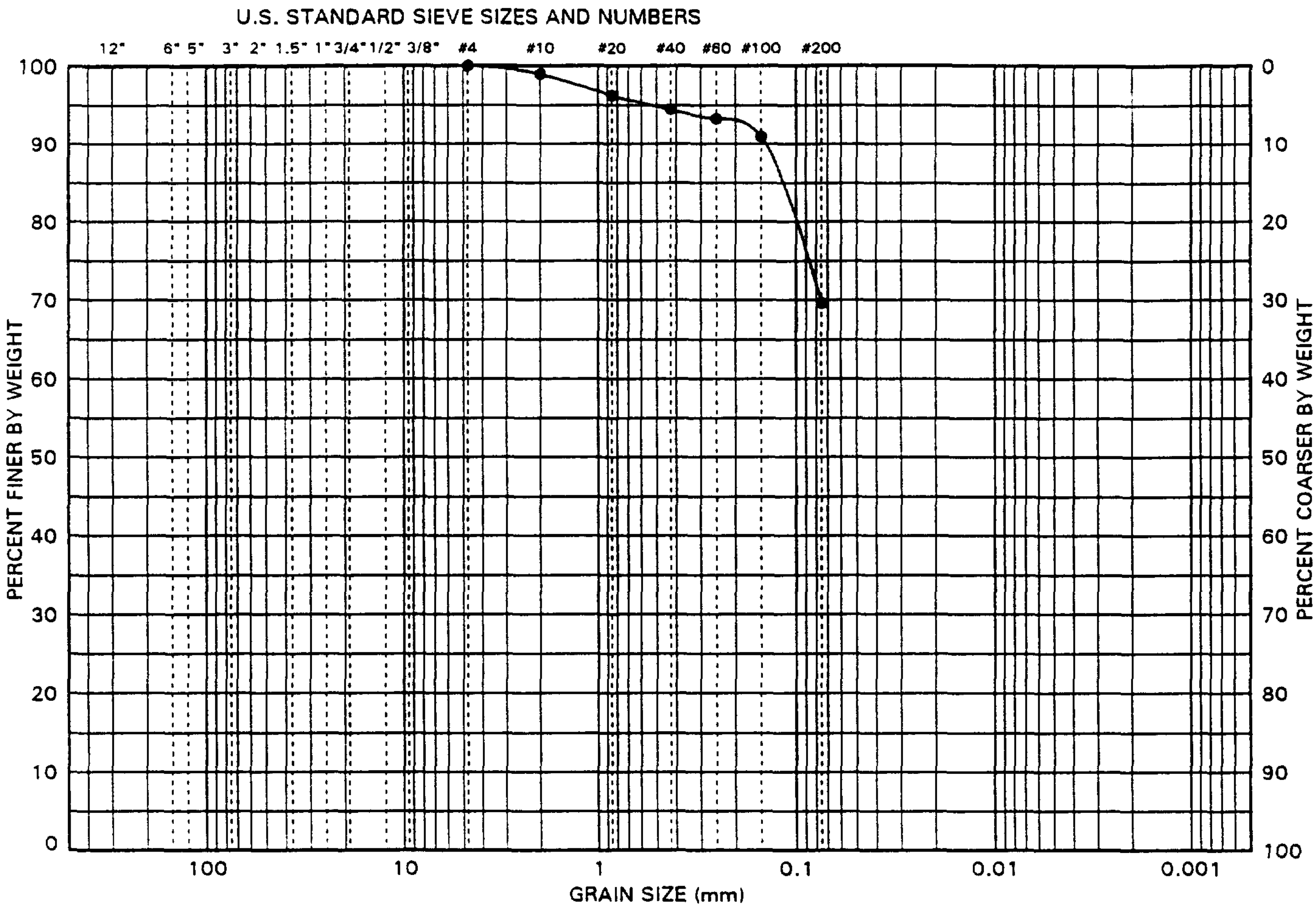
SOIL FRACTIONS

PERCENT PASSING U.S. STANDARD SIEVE SIZES AND NUMBERS														PERCENT FINER THAN HYDROMETER				
3"	2"	1.5"	1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200					
PERCENT PASSING SIEVE SIZES (mm)														PARTICLE DIAMETER (mm)				
75	50	37.5	25	19	12.5	9.5	4.75	2.00	0.850	0.425	0.250	0.150	0.075	0.050	0.020	0.005	0.002	0.001
100	100	100	100	100	100	100	100	99	97	95	95	90	81					

NOTES:

GEO SYNTEC CONSULTANTS Geomechanics and Environmental Laboratory Atlanta, Georgia	**FIGURE 2** PROJECT: BAILEY SITE PROJECT NO.: GE3913 DOCUMENT NO.: GEL96035

GS FORM: 4PS2 04/02/96	**PARTICLE SIZE DISTRIBUTION AND PHYSICAL PROPERTIES**	ASTM C 136, D 422, D 2487 D 3042 AND D 4318



BOULDERS	COBBLES	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
		GRAVEL		SAND			FINES	

SITE SAMPLE ID	B2	LIQUID LIMIT (%)	42	SOIL FRACTIONS	GRAVEL (%) 0.0
LAB. SAMPLE NO.	E96C06	PLASTIC LIMIT (%)	20		SAND (%) 30.4
SAMPLE DEPTH (ft)		PLASTICITY INDEX	22		FINES (%) 69.6
SOIL CLASSIFICATION: CL - Sandy Lean Clay					SILT (%)
					CLAY(%)
				COEFF. UNIFORMITY (Cu)	
				COEFF. CURVATURE (Cc)	

PERCENT PASSING U.S. STANDARD SIEVE SIZES AND NUMBERS														PERCENT FINER THAN HYDROMETER PARTICLE DIAMETER (mm)				
3"	2"	1.5"	1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200					
PERCENT PASSING SIEVE SIZES (mm)																		
75	50	37.5	25	19	12.5	9.5	4.75	2.00	0.850	0.425	0.250	0.150	0.075	0.050	0.020	0.005	0.002	0.001
100	100	100	100	100	100	100	100	99	96	94	93	91	70					

NOTES:

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Atlanta, Georgia

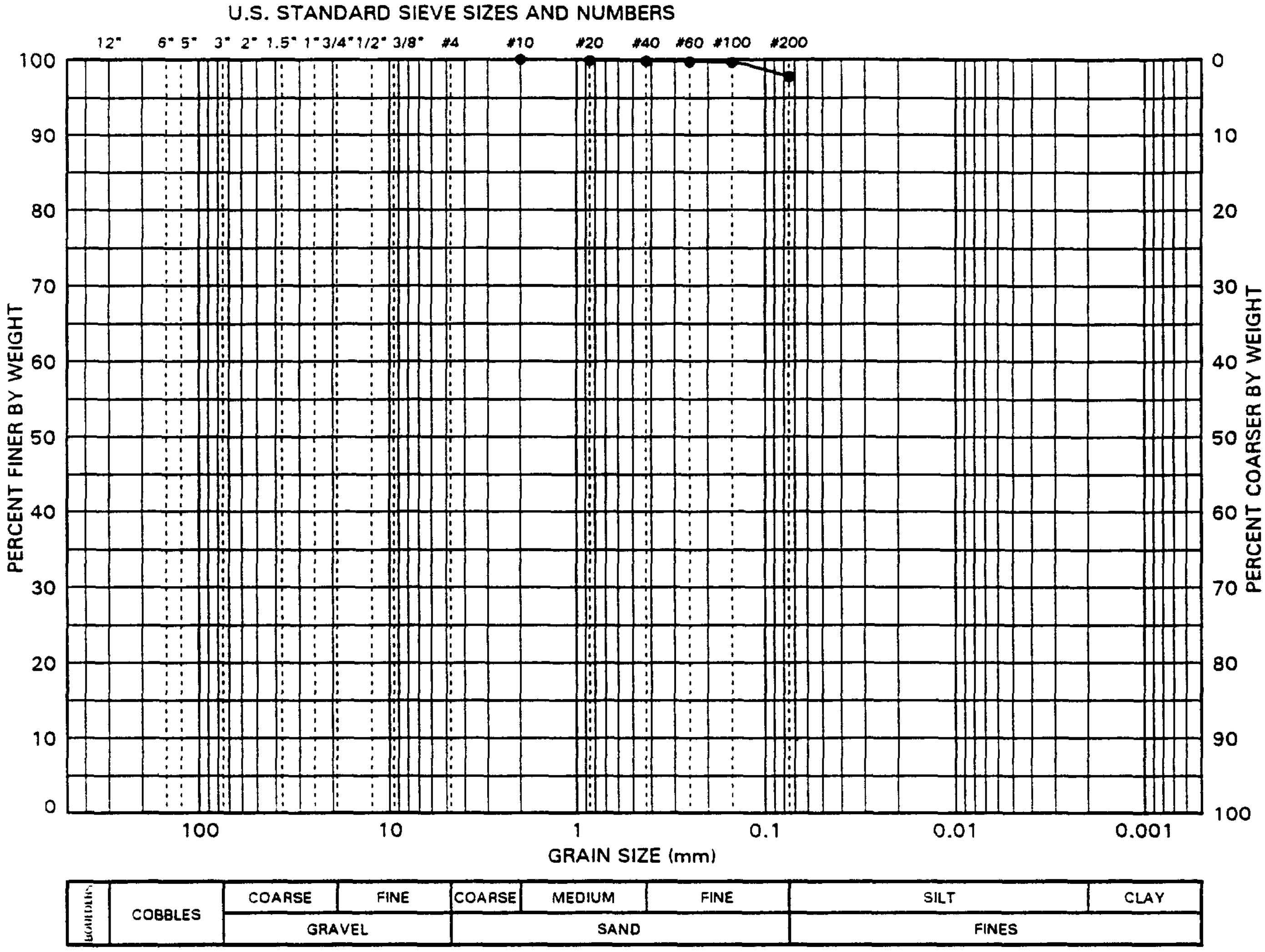
FIGURE 3

PROJECT: BAILEY SITE
PROJECT NO.: GE3913
DOCUMENT NO.: GEL96035

GS FORM: 4PS2 04/02/96

PARTICLE SIZE DISTRIBUTION AND PHYSICAL PROPERTIES

ASTM C 136, D 422, D 2487 D 3042 AND D 4318



SITE SAMPLE ID	D1	LIQUID LIMIT (%)	53	GRAVEL (%)	0.0
LAB. SAMPLE NO.	E96C08	PLASTIC LIMIT (%)	20	SAND (%)	2.2
SAMPLE DEPTH (ft)		PLASTICITY INDEX	33	FINES (%)	97.8
SOIL CLASSIFICATION: CH - Fat Clay				SILT (%)	
				CLAY (%)	
				COEFF. UNIFORMITY (Cu)	
				COEFF. CURVATURE (Cc)	

SOIL FRACTIONS

PERCENT PASSING U.S. STANDARD SIEVE SIZES AND NUMBERS														PERCENT FINER THAN HYDROMETER PARTICLE DIAMETER (mm)				
3"	2"	1.5"	1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200					
PERCENT PASSING SIEVE SIZES (mm)																		
75	50	37.5	25	19	12.5	9.5	4.75	2.00	0.850	0.425	0.250	0.150	0.075	0.050	0.020	0.005	0.002	0.001
100	100	100	100	100	100	100	100	100	100	100	100	100	98					

NOTES:

GEO SYNTEC CONSULTANTS
Geomechanics and Environmental Laboratory
Atlanta, Georgia

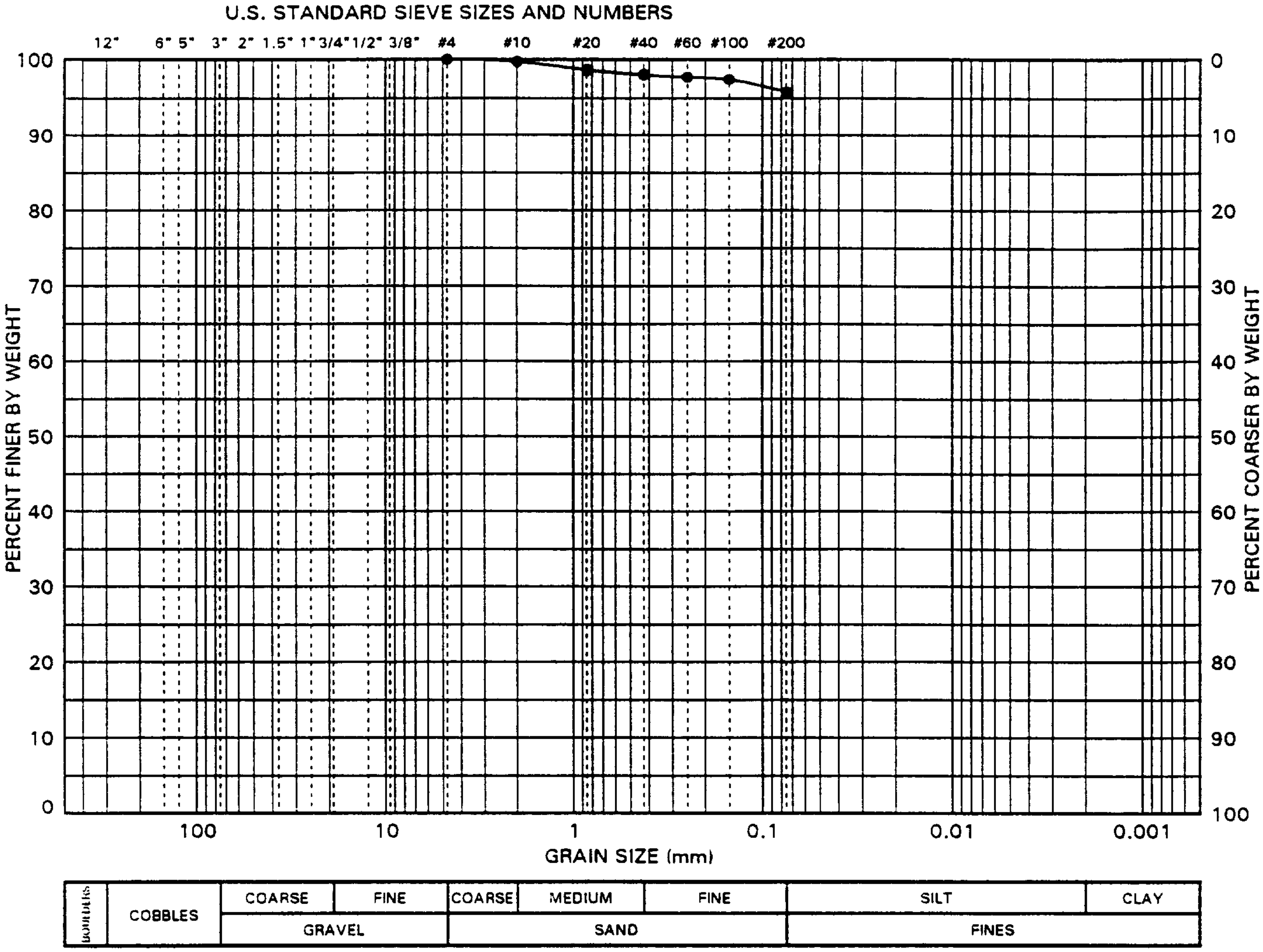
FIGURE 4

PROJECT: BAILEY SITE
PROJECT NO.: GE3913
DOCUMENT NO.: GEL96035

GS FORM: 4PS2 04/02/96

PARTICLE SIZE DISTRIBUTION AND PHYSICAL PROPERTIES

ASTM C 136, D 422, D 2487 D 3042 AND D 4318



SITE SAMPLE ID	E1	LIQUID LIMIT (%)	62	SOIL FRACTIONS: GRAVEL (%)	0.0
LAB. SAMPLE NO.	E96C10	PLASTIC LIMIT (%)	26	SAND (%)	4.2
SAMPLE DEPTH (ft)		PLASTICITY INDEX	36	FINES (%)	95.8
SOIL CLASSIFICATION: CH - Fat Clay				SILT (%)	
				CLAY(%)	
				COEFF. UNIFORMITY (Cu)	
				COEFF. CURVATURE (Cc)	

PERCENT PASSING U.S. STANDARD SIEVE SIZES AND NUMBERS														PERCENT FINER THAN HYDROMETER PARTICLE DIAMETER (mm)				
3"	2"	1.5"	1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200					
PERCENT PASSING SIEVE SIZES (mm)																		
75	50	37.5	25	19	12.5	9.5	4.75	2.00	0.850	0.425	0.250	0.150	0.075	0.050	0.020	0.005	0.002	0.001
100	100	100	100	100	100	100	100	100	99	98	98	98	96					

NOTES:

GEO SYNTEC CONSULTANTS
Geomechanics and Environmental Laboratory
Atlanta, Georgia

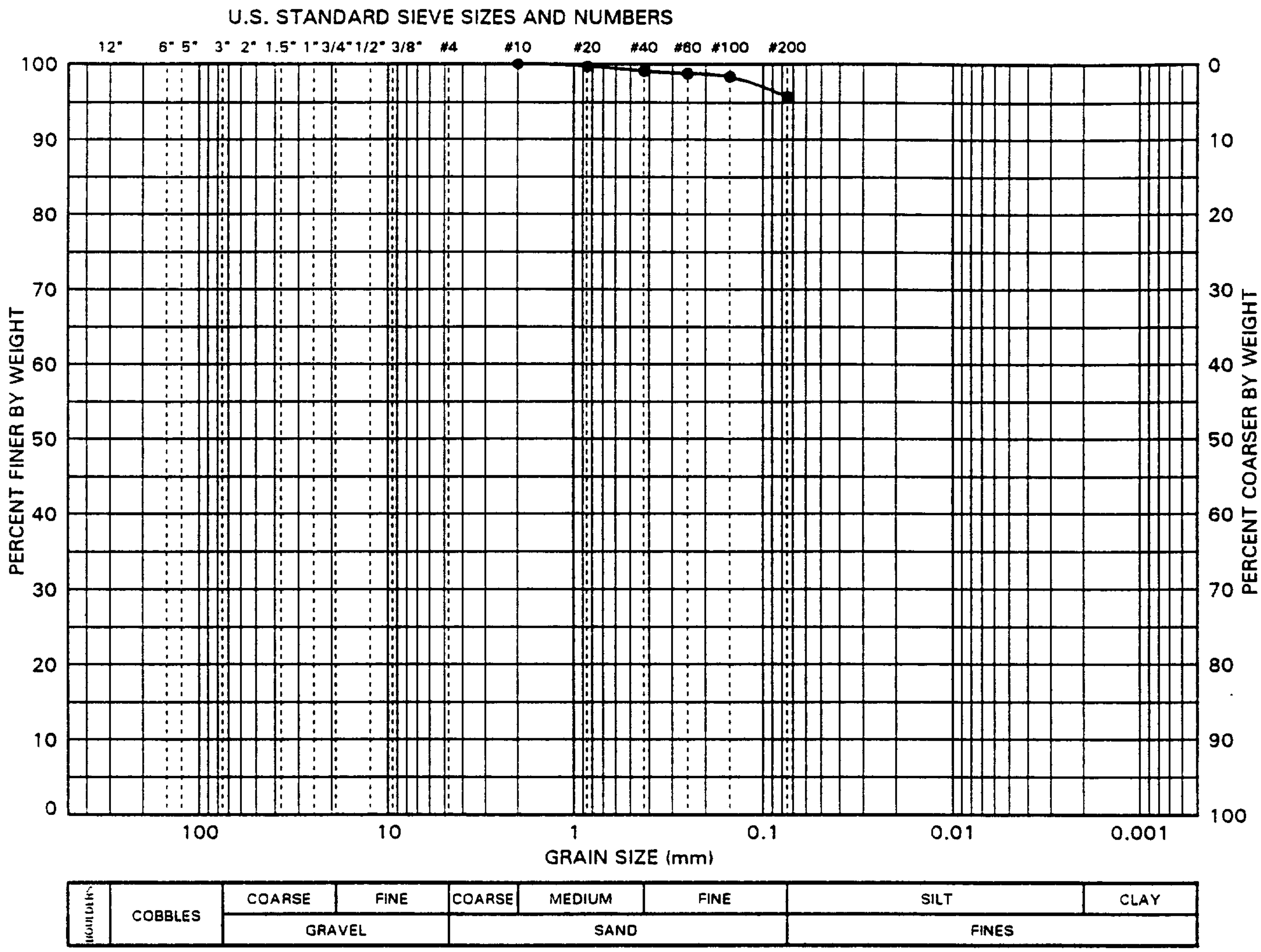
FIGURE 5

PROJECT: BAILEY SITE
PROJECT NO.: GE3913
DOCUMENT NO.: GEL96035

GS FORM: 4PS2 04/02/96

PARTICLE SIZE DISTRIBUTION AND PHYSICAL PROPERTIES

ASTM C 136, D 422, D 2487 D 3042 AND D 4318



SITE SAMPLE ID	F2	LIQUID LIMIT (%)	49	SOIL FRACTIONS	GRAVEL (%)	0.0
LAB. SAMPLE NO.	E96C11	PLASTIC LIMIT (%)	29		SAND (%)	4.3
SAMPLE DEPTH (ft)		PLASTICITY INDEX	20		FINES (%)	95.7
SOIL CLASSIFICATION: ML - Silt					SILT (%)	
					CLAY(%)	
					COEFF. UNIFORMITY (Cu)	
					COEFF. CURVATURE (Cc)	

PERCENT PASSING U.S. STANDARD SIEVE SIZES AND NUMBERS / PERCENT PASSING SIEVE SIZES (mm) / PERCENT FINER THAN HYDROMETER PARTICLE DIAMETER (mm)

3"	2"	1.5"	1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#100	#200					
75	50	37.5	25	19	12.5	9.5	4.75	2.00	0.850	0.425	0.250	0.150	0.075	0.050	0.020	0.005	0.002	0.001
100	100	100	100	100	100	100	100	100	100	99	99	98	96					

NOTES:

ATTACHMENT A

Sample Identification, Handling, Storage and Disposal

Laboratory Test Standards

Application of Test Results

SAMPLE IDENTIFICATION, HANDLING, STORAGE AND DISPOSAL

Test materials were sent to GeoSyntec Consultants (GeoSyntec) Geomechanics and Environmental Laboratory in Atlanta, Georgia by the client or its representative(s). Samples delivered to the laboratory were identified by client sample identification (ID) numbers which had been assigned by representative(s) of the client. Upon being received at the laboratory, each sample was assigned a laboratory sample number to facilitate tracking and documentation.

Based on the information provided to GeoSyntec by the client or its representative(s) and, when applicable, procedural guidelines recommended by an industrial hygiene consultant, the following Occupational Safety and Health Administration (OSHA) level of personal protection was adopted for handling and testing of the test materials:

[ ] test materials were not contaminated, no special protection measures were taken;
[X] level D
[ ] level C
[ ] level B

In accordance with the health and safety guidelines of GeoSyntec, contaminated materials are stored in a designated containment area in the laboratory. Non-contaminated materials are stored in a general storage area in the laboratory.

GeoSyntec Geomechanics and Environmental Laboratory will continue storing the test materials for a period of 30 days from the date of this report or a year from the time that the samples were received, which ever is shorter. Thereafter: (i) contaminated materials will be returned to the client or its designated representative(s); and (ii) the materials which are not contaminated will be discarded unless long-term storage arrangements are specifically made with GeoSyntec Geomechanics and Environmental Laboratory.

LABORATORY TEST STANDARDS

At the request of the client, the laboratory testing program was performed utilizing the guidelines provided in the following test standards:

[X] **moisture content** - American Society for Testing and Materials (ASTM) D 2216 "*Standard Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures*";

[ ] **moisture content** - ASTM D 4643 "*Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Method*";

[X] **particle-size analysis** - ASTM 422, "*Standard Method for Particle-Size Analysis of Soils*";

[X] **percent passing No. 200 sieve** - ASTM D 1140, "*Standard Test Method for Amount of Material in Soil Finer Than No. 200 (75 microns) sieve*";

[X] **Atterberg limits** - ASTM D 4318, "*Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*";

[X] **soil classification** - ASTM D 2487, "*Standard Test Method for Classification of Soils for Engineering Purposes*";

[ ] **soil pH** - ASTM D 4972, "*Standard Test Method for pH of Soils*";

[ ] **soil pH** - United States Environmental Protection Agency (USEPA) SW-846 Method 9045, Revision 1, 1987, Standard Test Method for Measurement of "*Soil pH*";

[ ] **specific gravity** - ASTM D 854, "*Standard Test Method for Specific Gravity of Soils*";

[ ] **carbonate content** - ASTM D 3042, "*Standard Method for Insoluble Residue in Carbonate Aggregates*";

[ ] **soundness** - ASTM C 88, *"Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate"*;

[ ] **loss-on-ignition (LOI)** - ASTM D 2974, *"Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils"*;

[ ] **standard Proctor compaction** - ASTM D 698, *"Standard Test Method for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-in. (305-mm) Drop"*;

[ ] **modified Proctor compaction** - ASTM D 1557, *"Standard Test Method for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop"*;

[ ] **maximum relative density** - ASTM D 4253, *"Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table"*;

[ ] **minimum relative density** - ASTM D 4254, *"Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density"*;

[ ] **mass per unit area** - ASTM D 3776, *"Standard Test Method for Mass Per Unit Area (weight) of Woven Fabric"*;

[ ] **thickness measurement** - ASTM D 1777, *"Standard Test Method for Measuring Thickness of Textile Materials"*;

[ ] **free swell** - United States Pharmacopeia National Formulary (USP-NF) XVII, *"Swell Index of Clay"*;

[ ] **fluid loss** - American Petroleum Institute (API)-13B, *"Section 4, Bentonite"*;

[ ] **marsh funnel** - API-13B, *"Section 4, Field Testing of Oil Mud Viscosity and Gel Strength"*;

[ ] **pinhole dispersion** - ASTM D 4647, *"Standard Test Method for Identification and Classification of Dispersive Clay Soils by the Pinhole Test"*;

[ ] **gradient ratio** - ASTM D 5101, *"Standard Test Method for Measuring the Soil-Geotextile System Clogging Potential by the Gradient Ratio"*;

[ ] **hydraulic conductivity ratio** - Draft ASTM D 35.03.91.01, *"Standard Test Method for Hydraulic Conductivity Ratio (HCR) Testing"*;

[ ] **hydraulic transmissivity** - ASTM D 4716, *"Standard Test Method for Constant Head Hydraulic Transmissivity (In-plane flow) of Geotextiles and Geotextile Related Products"*;

[ ] **one-dimensional consolidation** - ASTM D 2435, *"Standard Test Method for One-Dimensional Consolidation Properties of Soil"*;

[ ] **one-dimensional swell/collapse** - ASTM D 4546, *"Standard Test Method for One-Dimensional Swell or Settlement Potential of Cohesive Soils"*;

[ ] **unconfined compressive strength (UCS)** - ASTM D 2166, *" Standard Test Method for Unconfined Compressive Strength of Cohesive Soil"*;

[ ] **triaxial compressive strength ($\overline{\text{ICU}}$)** - ASTM D 4767, *"Standard Test Method for Triaxial Compression Test on Cohesive Soils"*;

[ ] **triaxial compressive strength (UU)** - ASTM D 2850, *"Standard Test Method for Unconsolidated, Undrained Compressive Strength of Cohesive Soils in Triaxial Compression"*;

[ ] **rigid wall constant head hydraulic conductivity** - ASTM D 2434, *"Standard Test Method for Permeability of Granular Soils (Constant Head)"*;

[X] **flexible wall falling head hydraulic conductivity** - ASTM D 5084, *"Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter"*;

[ ] **flexible wall falling head hydraulic conductivity** - U. S. Army Corp of Engineers; EM-1110-2-1906, *"Standard Test Method for Permeability Tests, Appendix VII"*;

[ ] **index flux of GCL** - proposed ASTM method rough draft # 1, 6/18/94, *"Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter"*;

[ ] **flexible wall falling head hydraulic conductivity** - Geosynthetic Research Institute (GRI) GCL-2, *"Standard Test Method for Permeability of Geosynthetic Clay Liners (GCLs)"*;

[ ] **permeability/compatibility** - USEPA Method 9100, SW-846, Revision 1, 1987, Standard Test Method for Measurement of *"Saturated Hydraulic Conductivity, Saturated Leachate Conductivity and Intrinsic Permeability"*;

[ ] **capillary-moisture** - ASTM D 2325, *"Standard Test Method for Capillary-Moisture Relationships for Coarse- and Medium-Textured Soils by Porous-Plate Apparatus"*;

[ ] **capillary-moisture** - ASTM D 3152, *"Standard Test Method for Capillary-Moisture Relationships for Fine-Textured Soils by Pressure-Membrane Apparatus"* and

[ ] **paint filter liquids** - USEPA Method 9095, SW-846, Revision 1, 1987, *"Paint Filter Liquids Test"*.

APPLICATION OF TEST RESULTS

The reported test results apply to the field materials inasmuch as the samples sent to the laboratory for testing are representative of these materials. This report applies only to the materials tested and does not necessarily indicate the quality or condition of apparently identical or similar materials. The testing was performed in accordance with the general engineering standards and conditions reported. The test results are related to the testing conditions used during the testing program. As a mutual protection to the client, the public, and GeoSyntec, this report is submitted and accepted for the exclusive use of the client and upon the condition that this report is not used, in whole or in part, in any advertising, promotional or publicity matter without prior written authorization from GeoSyntec.

APPENDIX D

WASTE CONDITIONING STUDY FOR PIT B WASTE